Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

REED CLARK ROLLINS, Editor-in-Chief

ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
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IVAN MACKENZIE LAMB
} Associate Editors

VOLUME 62

1960

The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

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Vol. 62 January, 1960 No. 733

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RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

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Subscriptions and orders for back issues (making all remittances payable to RHODORA) should be sent to Albert F. Hill, Botanical Museum, Oxford Street, Cambridge 38, Mass.

Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

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NEW SPECIES OF FERNS FROM CENTRAL AND SOUTH AMERICA

ROLLA TRYON

The following five new species have been recognized among specimens received for identification and during studies on the ferns of Peru.[1]

Hemitelia conformis, spec. nov. FIG. 1

Cnemidaria; species *H. petiolatae* et *H. Woronovii* affinis; caulis ad 8 m. altus petiolus basaliter spinosus lamina bipinnata pinnae imparipinnatae pinnulae petiolulatae articulatae crenatae vel pinnatilobatae pinnula terminalis articulata productione laterali infra articulum venae plerumque liberae areolis costalis infrequentibus indusium inferius squamoideum.

TYPUS: Piñas Bay, Prov. Darién, Panama, June 26, 1957, *W. L. Stearn & K. L. Chambers 188* (GH); isotypi: (US, Y).

Hemitelia conformis is evidently closely related to both *H. petiolata* Hook. and *H. Woronovii* Maxon & Morton. It differs from them in its imparipinnate pinnae, each having a conform, stalked and articulate terminal pinnule and in the few costal areolae of the pinnules. The latter two species have the apex of the pinna formed of several gradually reduced and confluent segments and lobes, and the veins of the pinnules regularly join to form costal areolae. All three species are arborescent but *H. conformis* is evidently the tallest of them.

1 The drawings have been made by Mr. Johannes von Gumppenberg and the photographs by Mr. Richard van Frank.

It is also related to *H. dissimilis* Morton from which it differs, among other characters, in the articulate terminal pinnules, partially areolate venation, non-alate pinna-rachis and arborescent habit. *H. dissimilis* has non-articulate terminal pinnules, is wholly free-veined, the pinna-rachis is

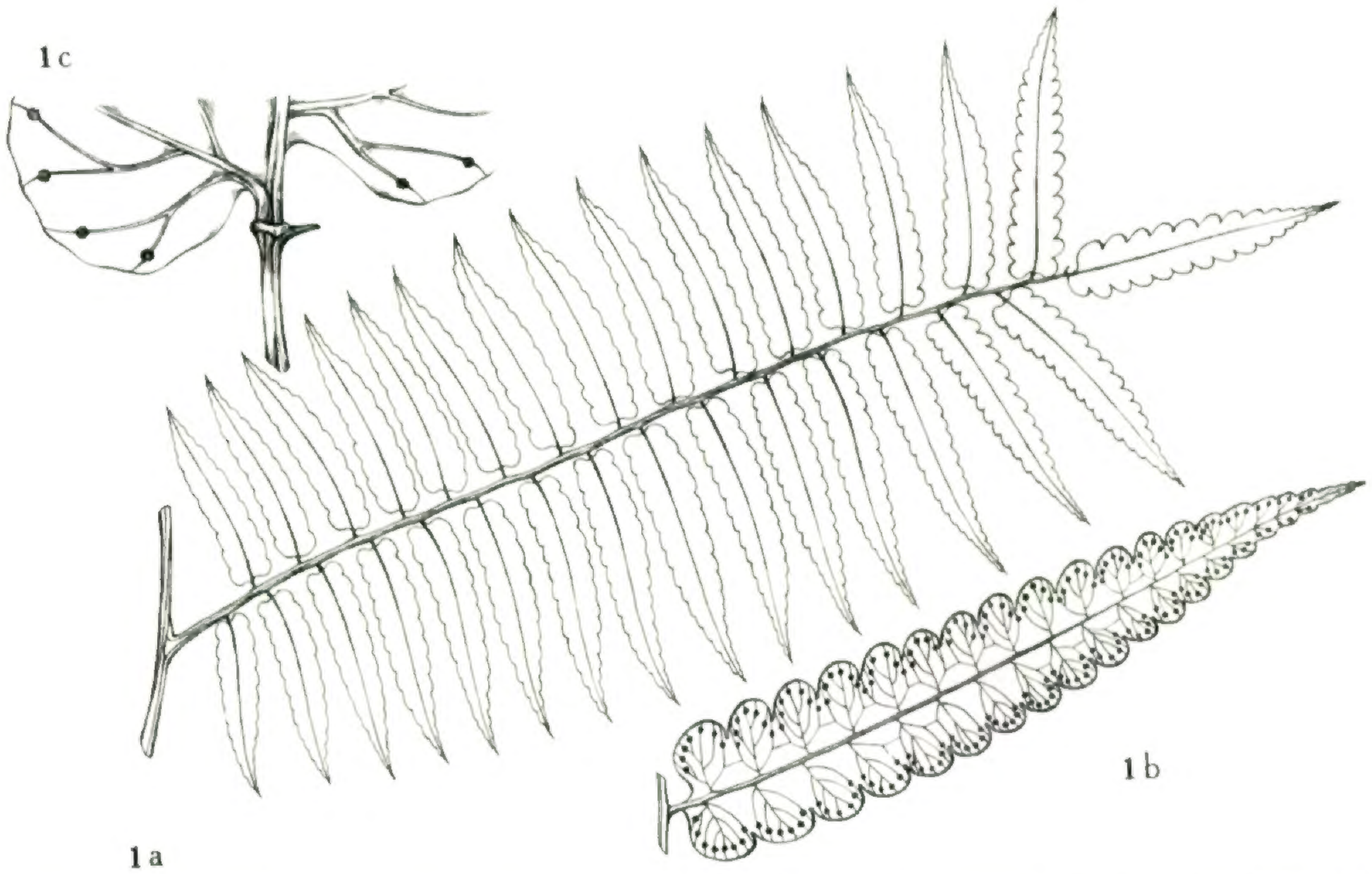

FIG. 1. *Hemitelia conformis* Tryon. 1a, pinna, X ¼; 1b, pinnule, X 2/3; 1c, base of terminal pinnule, X 2 2/3. All from the holotype.

strongly alate, especially apically, and the stem is some 15 cm. tall.

The unusual nature of the terminal pinnule, being borne on an articulate stalk which has a lateral projection just below the joint, strongly suggests that it was a lateral pinnule that has been displaced with the abortion of the original apical portion of the pinna.

Alsophila scopulina, spec. nov. FIG. 2

Caulis juvenis erectus senior decumbens ad 30 cm. longus circa 3 cm. crassus paleaceus paleis angusto-linearibus pallide fuscis folia ad 7-45 cm. longa 3.5-14 cm. lata passim pubescentia petiolus 1/4-1/3 laminae longitudinis ad basem paleaceus paleis angusto-linearibus integris vel rare denticulatis lamina oblongo-lanceolata acuminata herbacea pinnato-pinnatifida vel bipinnato-pinnatifida pinnae breviter petiolulatae vel sessiles venae liberae sori exindusiati paraphysati receptaculo leviter allevato 8-12 sporangiis sporangia plerumque brev-

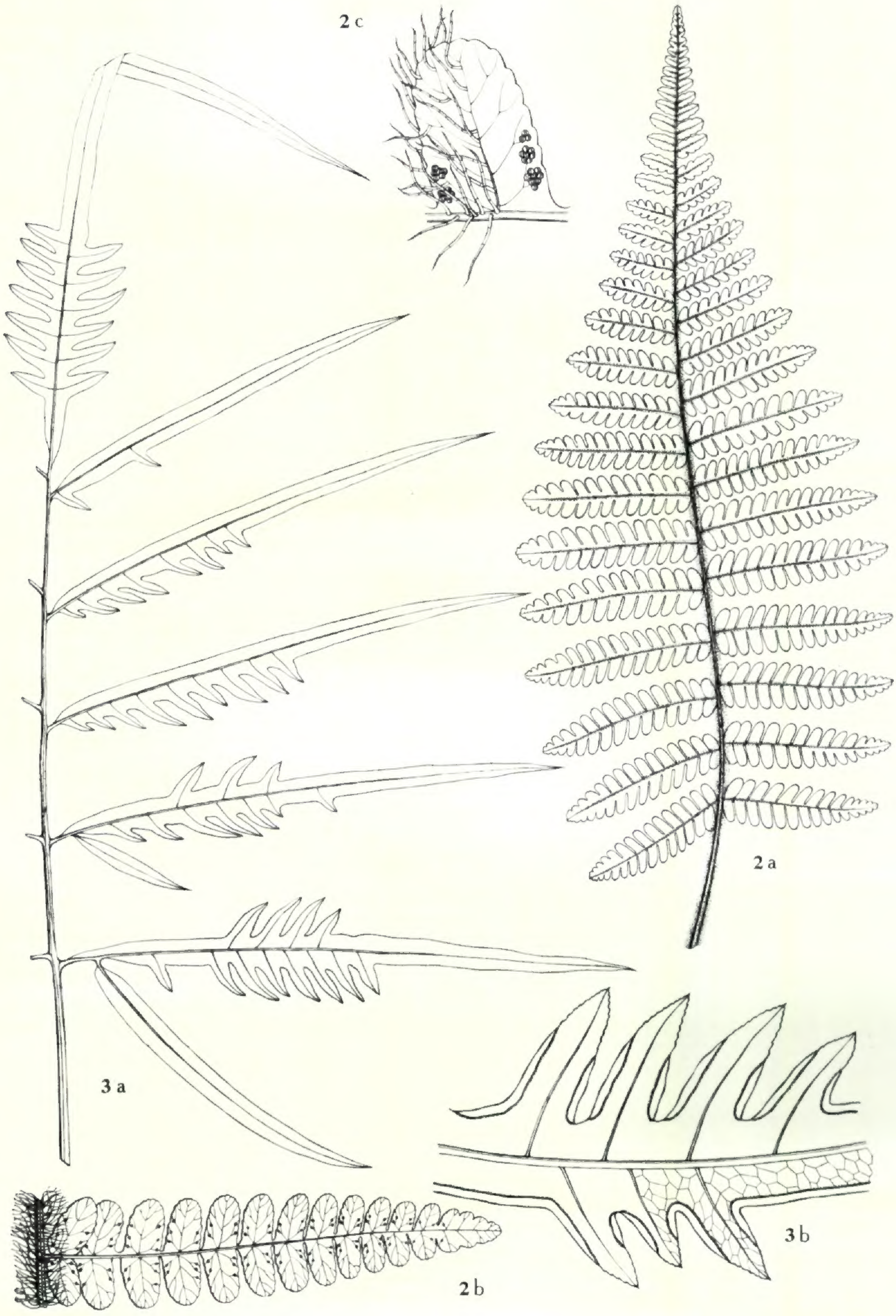

FIG. 2. *Alsophila scopulina* Tryon. 2a, lamina, X ½; 2b, pinna, X 1; 2c, ultimate segment, X 3. All from *Schultes and Cabrera 14741;* only a portion of the pubescence has been shown in each drawing. FIG. 3. *Pteris petiolulata* Tryon. 3a. fertile lamina, X ¼; 3b, portion of a fertile pinna, X 1. Both from the holotype.

iter pedicellata capsula ad 0.25-0.3 mm. longa asymmetricali subglobosa sporae flavae tetrahedro-globosae verrucosae.

TYPUS: Río Kananarí (affluent of Río Apaporis), in clumps on sandstone cliff, summit of Cerro Isibukuri, Vaupés, Colombia, June 8, 1951, *R. E. Schultes & I. Cabrera 13411* (GH); isotypi: (B, BM, NY, U, US). Paratypi: (from the same locality) *Schultes & Cabrera 13368* (US), *14740* (GH), *14741* (GH).

This species is very closely related to the next, *A. lechria*. The principal difference is that *A. scopulina* has all of the scales at the base of the petiole narrowly linear (the broader ones 8 cells wide) and entire or rarely sparingly dentate while *A. lechria* has some broad scales at the base of the petiole, in addition to the narrow ones. The broad scales are lanceolate-attenuate and about 20 cells wide, and these as well as the narrow ones are freely dentate or ciliate. Also the petiole is relatively short in *A. scopulina*, being one fourth to one third as long as the lamina, while in *A. lechria* it is longer, about one half as long as the lamina. The spores are of a different color in the two species but this may not be a specific character.

Alsophila lechria, spec. nov. PLATE 1251

Species *A. scopulinae* valde affinis, differt petiolo ca. 1/2 laminae longitudinis paleis ciliatis vel denticulatis angusto-linearibus et lanceolatis attenuatis sporis albis. — Caulis decumbens ad 40 cm. longus circa 3 cm. crassus paleaceus paleis angusto-linearibus pallide fuscis folia ad 25-70 cm. longa 8-25 cm. lata passim pubescentia lamina lanceolata chartacea pinnato-pinnatifida vel bipinnato-pinnatifida pinnae breviter petiolulatae venae liberae sori exindusiati paraphysati receptaculo modice allevato 8-14 sporangiis sporangia plerumque breviter pedicellata capsula ad 0.25-0.3 mm. longa asymmetricali lachriformi-globosa sporae albae tetrahedro-globosae verrucosae.

TYPUS: Rocky ledge, Mesa do los Santos, Dept. Santander, Colombia, 1500 m., Dec. 11-15, 1926, *E. P. Killip & A. C. Smith 15202* (GH); isotypus: (US).

The epithet is from *L E C H R I O S*, oblique, in reference to the decumbent stem.

REMARKS ON ALSOPHILA. — These two new species of *Alsophila* are of considerable interest because they approach the genus *Lophosoria* in several characters. As I first studied the material of *A. scopulina* I was inclined to consider it to

represent a new genus intermediate between *Alsophila* and *Lophosoria*. However, after additional study, I believe they are better placed in *Alsophila*.

Lophosoria is characterized by a 6-rowed sporangial stalk

PLATE 1251 *Alsophila lechria* Tryon, from the holotype.

and a pubescent stem that is erect when young but becomes decumbent or prostrate with age, a pubescent leaf, a sorus with about 7-10 subsessile sporangia that are produced at the same time, these are borne on an essentially flat receptacle and have a large (0.4-0.5 mm. long) capsule that is somewhat asymmetrically subglobose.

The two new species resemble, or approach, *Lophosoria* in their decumbent mature stem, in their sorus with few (8-14) short-stalked sporangia that are borne on a slightly elevated receptacle and have a rather large (0.25-0.3 mm. long) capsule of rather similar shape. The sporangia of a given sorus evidently mature, and perhaps are produced, at one time. The presence of scales at the base of the petiole that are only two cells wide mixed with trichomes and broader scales is suggestive of a transitional type of indument.

Alsophila has a 4-rowed sporangial stalk and a paleate stem, and most species have an erect stem, broad scales at the base of the petiole (scales and trichomes may be on other parts of the leaf as well), a sorus with about 25-30 definitely stalked sporangia that are produced in a basipetal sequence, these are borne on an elevated receptacle and have a small (0.15-0.2 mm. long) capsule that is asymmetrically lachriform and somewhat laterally compressed.

The new species have the 4-rowed sporangial stalk and paleate stem and petiole base of *Alsophila*. Their other sporangial and soral characters and their narrow scales do not separate them from *Alsophila*. A survey of some 100 species of American *Alsophila* has shown that several of them depart from some of the characters previously mentioned for the genus and in these approach, or are similar to, the new species. Such species are: *A. trichiata* Maxon (the closest to *A. scopulina* and *A. lechria*), *A. microdonta* Desv., *A. stipularis* Christ, *A. ursina* Maxon, *A. villosa* (Willd.) Desv., *A. lasiosora* Mett. ex Kuhn, *A. dichromatolepis* Fée and *A. corcovadensis* (Raddi) C. Chr. Among them are found the following characters: narrow scales at the base of the petiole, a sorus with 12-16 short-stalked sporangia that are

borne on a very moderately elevated receptacle and apparently mature at one time and have a lachriform-globose capsule that is 0.3 mm. long.

Although the new species represent one extreme in the genus *Alsophila*, it is evident that they are a part of its total range of variation.

It is of interest to note that, with the exception of *A. ursina*, other small species such as *A. Gleasonii* Maxon, *A. Haughtii* Maxon, *A. Kuhnii* (Hieron.) C. Chr., *A. phalaenolepis* C. Chr. and *A. phegopteroides* Hook. show no close relationship to the two new ones.

Cheilanthes fractifera, spec. nov. PLATE 1252

Species *Ch. Brandegei* valde affinis, differt paleis basalibus petiolorum latis albidis denticulatis lamina pilis multis 2-5 cellulorum. — Rhizoma breve paleis opacis fuscis concoloribus petioli propinqui fracturis supra basis post maturi lamina bipinnato-pinnatifida pinnis 5-6 jugis basalibus magnis rhachis sulcata supra basem alata segmenta lata herbacea.

TYPUS: 45 kms. from Nasca on road to Puquio, Dept. Ayacucho, Peru, 2200 m. Feb. 14, 1958, *D. S. Correll & E. E. Smith P169* (GH); isotypus: (LL). Paratypus: rocky hillside, km. 68, Carretera Central (Rimac Valley), Dist. Surco, Prov. Huarochiri, Dept. Lima, Peru, ca. 6000 ft., Jan. 1, 1954, *S. G. E. Saunders 219* (GH ex BM).

This new species differs from *Cheilanthes Brandegei* D. C. Eaton in having the lamina rather abundantly invested with 2 to 5-celled trichomes (mostly variously bent) and in having the several scales at the base of the petiole whitish, broad and with denticulate margins. *Cheilanthes Brandegei* has the lamina sparingly invested with 1-celled, straight and pointed trichomes and the scales at the base of the petiole are few, rather narrow, brown, and with entire margins.

The two species are very closely related and are similar in the following characters: rhizome scales concolorous and dull, petioles that fracture with age toward their base (one to several times), rather deltoid lamina with the basal pinnae large, rachis sulcate on the upper side and alate above the base, few nearly opposite pinnae with thin and broad ultimate segments and flattened trichomes, indusium of similar form and modification.

Such pairs of related species as *Notholaena incana* Pr. (primarily Mexico) and *Notholaena nivea* (Poir.) Desv. (primarily Andean South America) and *Cheilanthes pyra-*

PLATE 1252 *Cheilanthes fractifera* Tryon, from the holotype.

midalis Fée (primarily Mexico) and *Cheilanthes marginata* HBK. (Andean South America) have broader distributions

than *Cheilanthes Brandegei* (Baja California) and *Cheilanthes fractifera* (Peru) but of a similar pattern.

Two species of South Africa seem to be most closely related to these two American *Cheilanthes*. *Cheilanthes deltoidea* Kze. especially in its freely fracturing petioles and *Cheilanthes capensis* (Thunb.) Sw. in its broad thin segments and often similar lamina. The distribution of *Pellaea andromedifolia* (Kaulf.) Fée (California), *Pellaea myrtillifolia* Mett. ex Kuhn (Chile) and *Pellaea rufa* A. F. Tryon (South Africa) would be parallel to that of this *Cheilanthes* alliance.

Among other Cheilanthoid ferns the fracturing petiole is also found in *Pellaea Breweri* D. C. Eaton, *Cheilanthes rigida* (Sw.) Fée and *Cheilanthes pteridioides* (Reich.) C. Chr. This character may or may not be one that indicates phyletic relationship. It seems to be especially developed in species with leaves that have relatively thin and broad segments and that grow in relatively dry — but seasonally moist — habitats. The leaves can probably resist desiccation only slightly and once dry can not remain viable. The effective cutting off of the leaves by the breaking of the petiole may aid in the conservation of moisture in the rhizome. Most xeric ferns, on the other hand, have coriaceous leaves that not only can resist desiccation to a certain degree but evidently can also remain viable while dry for at least a short time. These can remain functional during a growing season broken by short dry periods. The former species actively grow in the xeric habitats only when they are seasonally mesic; the latter can actively grow in such habitats for a longer period of time.

Pteris petiolulata, spec. nov. FIG. 3

Species *Pteris Fraseri* affinis, differt pinnis petiolulatis vel versus apicem laminarum sessilibus segmentis areolis 3-5 stichorum maximis ca. 4-6 mm. longis. — Rhizoma modice parva erecta folia circa 0.75-1.5 m. longa pinnae pubescentes praesertim in costa et marginibus plerumque integrae vel inequaliter lobatae vel pinnatifidae vel cum pinnula integra marginibus sterilibus integris vel versus apicem segmentorum serrulatis costa supra sine aristis venis areolati prominentes.

TYPUS: La Merced, Dept. Junín, Peru, ca. 4000 ft., Aug. 27-Sept. 1, 1923, *J. F. Macbride 5714* (US); isotypus: (F).

Pteris petiolulata grows in forests at low to moderate elevations, from Venezuela to Peru. In addition to the type-collection, I have seen the following specimens: VENEZUELA: Cerro Duida, *Steyermark 57982* (US); COLOMBIA: La Cumbre, Dept. El Valle, *Killip 5844* (GH, US), 6 km. west of Medina, Dept. Cundinamarca, *Grant 10421* (US); PERU: Río Pachiri, Dept. Cuzco, *Bües 1767* (US), San Ramón, Dept. Junín, *Killip & Smith 24696* (GH, US).

The irregular development and spacing of the lobes and segments on the pinnae is suggestive of a hybrid origin but there seems to be no other evidence for it. The sporangia, the spores and their number in a sporangium appear quite normal. Although a hybrid of *Pteris grandifolia* L. and *Pteris vestita* Baker would probably be similar to *Pteris petiolulata*, *Pteris vestita* is not known outside of Peru.

This species has been confused with *Pteris Fraseri* Mett. ex Kuhn of Ecuador from which it differs principally in its stalked or sessile pinnae, its small areoles (the largest 4-6 mm. long) and the number of rows of areoles between the costa and margin, usually three rows in narrow segments and five rows in broad ones. *Pteris Fraseri* has only the basal pinnae stalked, the lamina above them is pinnatipartite, the largest areoles are 10-15 mm. long and there are usually two rows of them in narrow segments and three (rarely four) in the broadest ones.

Pteris denticulata Sw. of the West Indies to Brazil, Argentina and Bolivia, is related to both *Pteris petiolulata* and *Pteris Fraseri*; it differs from these in having the sterile margins serrate-spinescent, rather than entire to serrulate.

— GRAY HERBARIUM OF HARVARD UNIVERSITY.

THE AMERICAN CRUCIFERAE OF SESSÉ AND MOCINO

Reed C. Rollins

The publication of two separate books[1] on the flora of Mexico a century after they were largely prepared by Sessé and Mociño introduced many plant names into the literature that have never been satisfactorily interpreted. Some of these were new at the time of publication. Others are misapplications, usually arising from misidentifications. Very often the misapplication is completely outside of the proper genus, leading to a great deal of confusion. To take an example from the Cruciferae, the name *Arabis pinnata* has been in the records since its publication in 1889 but there has been no understanding of its application. The specimen labeled *Arabis pinnata* in the Sessé and Mociño collection belongs to the wholly unsuspected genus *Rorippa*. As suggested by Sprague[2], for the interpretation of Sessé and Mociño's descriptions it is crucial to study the original specimens from the Madrid Botanical Garden and the drawings copied under the direction of A. P. DeCandolle from the originals of Sessé and Mociño. The latter were apparently lost sometime after having been copied.

In the present study, I have been fortunate to have available for careful examination the specimens of Cruciferae collected in "Nueva España" by Sessé, Mociño, Castillo and Moldano, now on loan from the Madrid Botanical Garden to the Chicago Natural History Museum. Furthermore, one of the copy-sets of tracings of "Calques des Dessins de la Flore du Mexique, de Mociño et Sessé" is in the Gray

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1 Sessé, Martino et Josepho Mariano Mociño. Plantae Novae Hispaniae. 1-184. 1887-1890. Originally published in La Naturaleza, Volume 1, series 2. For dates of publication see Lloydia 5:95-96. 1942. Edition 2 with different pagination published in 1893.

Sessé, Martinus et Josephus Mariannus Mociño. Flora Mexicana. 1-263. 1891-1897. Pages 1-125 published before edition 2 in La Naturaleza, Volume 2, series 2. Edition 2 with different pagination published in book form in 1894.

2 Sprague, T. A. Sessé and Mociño's Plantae Novae Hispaniae and Flora Mexicana. Kew Bull. 1926: 417-423. 1926.

Herbarium library and has been helpful in the interpretation of *Nasturtium mexicanum*.

On the whole, the specimens of Sessé and Mociño are adequate for identification and some of them were beautifully prepared. Several sheets have two different species mounted on them. These mixtures might have taken place during the handling of the specimens subsequent to their original collection but such mixtures in the Cruciferae occur quite frequently at the time the material is gathered even with the best collectors. At the present it is not possible to guess as to how the mixtures might have come about.

In the notes that follow, the genera and species represented in the collection are given alphabetically, together with pertinent comments. This is followed by a listing of the names that appear in the various editions of Sessé and Mociño's Plantae Novae Hispaniae and their Flora Mexicana, together with the modern name to which each should be referred whenever this could be determined.

Arabis — probably *A. Stellari* DC. The sheet numbered 3341 has an old label marked "15-2 Brassica violacea". The specimens, though in flower and young fruit only, are certainly *Arabis*, but they do not belong to any known Mexican species. They do compare favorably with material of *A. Stellari* from eastern Asia and I believe they represent that species.

Brassica campestris L., Sp. Pl. 666. 1753. Sheet number 3344 is a mixture, having one plant of *B. campestris* and one plant of *Romanschulzia arabiformis* on it.

Brassica nigra (L.) Koch in Roehl. Deutschl. Fl. 3: 713. 1833, based on *Sinapis nigra* L., Sp. Pl. 668. 1753. Sheet No. 3347 has an old label with some descriptive matter pertaining to the silique and foliage. In addition, this label bears the misspelled generic name "*Synapis*" plus "15-2" and an undecipherable word associated with Synapis.

Cakile lanceolata (Willd.) O. E. Schulz in Urban, Symb. Antill. 3: 504. 1903, based on *Raphanus lanceolatus* Willd.. Sp. Pl. 3: 562. 1800. There are two sheets of number 3348

with old labels giving "15-2 Raphanus Raphanistrum" and each sheet has several pieces of plant on it. The characters of *Cakile lanceolata* are well shown by the material and it is assumed that the specimens were gathered somewhere along the coast of Mexico or Central America.

Cochlearia — probably *C. officinalis* L. Sheet number 3358 bears old labels marked "15-2 Subularia aquatica". In the envelope on this sheet are two plants of *Cochlearia* and one plant belonging to the Caryophyllaceae which I have not attempted to identify. Certainly, the *Cochlearia* did not come from Mexico or the Central American area.

Descurainia streptocarpa (Fourn.) O. E. Schulz, Pflanzenr. IV. 105: 317. 1924, based on *Sisymbrium streptocarpum* Fourn., Recherch. Crucif. 58. 1865. The one sheet numbered 3362, having parts of three plants present, is referred to *Descurainia streptocarpa* without certainty because there are only young siliques available for examination. However, all of the characteristics shown by the specimens do compare favorably with authentic material of *D. streptocarpa.*

Draba jorullensis H. B. K., Nov. Gen. et Sp. Pl. 5:78. 1821. Excellent specimens of *Draba jorullensis* are present on sheet No. 3346, which has "15-1 Bunias orientalis" on the original label. A second collection, No. 3359, consists of two sheets. The old label gives "15-1 Subularia?" followed by a fairly adequate description of the calyx, corolla and silique. The two collections are slightly different but both fall within the overall variation of *D. jorullensis* as treated in Hitchcock's monograph[3].

Eruca sativa Gars., Traite Pl. Anim. 2:166. 1767. One plant and part of another of this species are on Sheet No. 3343, together with the top of a plant of *Nasturtium Gambelii* (Wats.) Schulz. The old label reads "15 . . . 2 Brassica Eruca".

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3 Hitchcock, C. Leo. A Revision of the Drabas of Western North America. Univ. Wash. Publ. Biol. 11:95-96. 1941.

Halimolobos Berlandieri (Fourn.) O. E. Schulz, Pflanzenr. IV. 105:289. 1924, based on *Sisymbrium Berlandieri* Fourn. Recherch. Crucif. 105. 1865. A sheet bearing No. 3339 and with an old label reading "15-2 Brassica" has a mixture of *H. Berlandieri* and *Pennellia patens* (Schulz) Rollins. Otherwise, *H. Berlandieri* is represented in the collection by No. 3350, which consists of 2 sheets, one of which bears on the original label "15-2 Erysimum". A fourth sheet of *H. Berlandieri* has been assigned No. 3352 and the original label on it reads "15-2 Sisymbrium".

Halimolobos polyspermus (Fourn.) O. E. Schulz, Pflanzenr. IV. 105:294. 1924, based on *Sisymbrium polyspermum* Fourn. Recherch. Crucif. 103. 1865. A single sheet belonging to *H. polyspermus* and with the old label reading "15-2 Turritis?" is present in the collection.

Lepidium sordidum Gray, Pl. Wright. 1:10. 1852. The collection now numbered 3355 bears "15-1 Lepidium ruderale" on the old label, together with some descriptive material on the flowers and foliage. The two plants present on the sheet are more comparable to other specimens of *L. sordidum* from the region of Mexico City than to those from farther north in Mexico or from Texas.

Lepidium virginicum L., Sp. Pl. 645. 1753. Number 3363 with an old label giving the name "Clipeola mexicana N." is referable to *Lepidium virginicum*. This early record, although not conclusive, certainly is evidence in support of the probability that *L. virginicum* is native to Mexico and not merely an introduced weed, as some have contended.

Lesquerella argyraea (Gray) Watson, Proc. Am. Acad. 23:254. 1888, based on *Vesicaria argyraea* Gray, Bost. Jour. Nat. Hist. 6: 146. 1850. An unpublished name, "Miagrum occidentale" appears on the original label of the specimen referable to *L. argyraea*. There is no indication as to the place of collection. The number 15-1 is in the original handwriting and the number 3357 has been added.

Lesquerella argentea (Schauer) Watson, Proc. Amer. Acad. 23:252. 1888, based on *Vesicaria argentea* Schauer,

Linnaea 20:720. 1847. Number 3360 bears the old label "Subularia? cl. 14 N. E." Other than the word *Subularia*, there is no significance in the label information for me. The specimen is in good fruit and is well preserved. The siliques are strongly flattened contrary to the septum and the replum has a lanceolate shape. Actually, this Sessé-Mociño specimen adds another facet of variation to that heretofore recognized in *Lesquerella argentea*. The value of the specimen for study would be considerably enhanced if some locality information for it were available.

Nasturtium Gambelii (Wats.) O. E. Schulz, Bot. Jahrb. 66:98. 1933, based on *Cardamine Gambelii* Watson, Proc. Amer. Acad. 11:147. 1876. There is a sheet of *N. Gambelii* marked "15-2 Erysimum" on the old label and assigned the new number 3349. A second sheet, with the new number 3343, is a mixture of *N. Gambelii* and *Eruca sativa*. Although no locality data are given, the specimens almost certainly came from the Valley of Mexico, for they are closely similar to *Pringle 6318* and *Bourgeau 18*, both of which came from the Mexico City area. *N. Gambelii* has a peculiarly restricted distribution in two widely separated areas, southern California and the Valley of Mexico. The type comes from Santa Barbara, California, and is nearly glabrous as are other specimens from there and from Los Angeles. However, material from San Bernardino has leaf-rachises, upper stems and pedicels hirsute with flat trichomes. The pedicels tend to be flattened and the upper surface only is hirsute. The same type of trichomes and the pattern of trichome distribution, as in the San Bernardino material, is found on specimens from Mexico.

Nasturtium Gambelii is in many ways similar to *N. microphyllum* [*N. officinale* var. *microphyllum*] and appears to be more properly placed in *Nasturtium* than in *Cardamine*, where most authors have treated it.

Pennellia patens (O. E. Schulz) Rollins, comb. nov., based on *Heterothrix patens* O. E. Schulz, Pflanzenr. 4. fam. 105. 296. 1924. The upper part of a single plant of *Pennellia*

patens is present on a sheet, No. 3339, which also has on it the upper part of a plant of *Halimolobos Berlandieri* (Fourn.) Schulz.

Pennellia longifolia (Benth.) Rollins, comb. nov., based on *Streptanthus longifolius* Bentham, Pl. Hartweg. 10. 1839. Number 3338 with the old label showing "15-2 ic. D"; 2 sheets of No. 3354 with the old label bearing "15-2 Turritis?" and No. 3361 with the old label bearing "15-2 Genus . . . Yc. D." all belong to *Pennellia longifolia*. This species has been variously known under the generic names *Streptanthus*, *Thelypodium*, and *Lamprophragma*. However, there is no doubt about the close affinity of *Pennellia micrantha*, the type species of *Pennellia*, and *P. longifolia*. In early stages of growth and up to and including early flowering, it is difficult to distinguish between *P. micrantha*, *P. longifolia* and *P. patens*. Certainly they should be together in the same genus. They are out of place in both *Streptanthus* and *Thelypodium*. The genus *Pennellia* was founded by Nieuwland to replace the later homonym *Heterothrix* of Rydberg, which in turn was based on *Streptanthus micranthus*. *Pennellia* thus becomes the logical choice to accommodate the two species here considered.

Romanschulzia arabiformis (DC.) Rollins, Contrib. Dudley Herb. 3: 221. 1942, based on *Nasturtium arabiforme* DC., Syst. 2:200. 1821. Three numbers belong to *R. arabiformis* as follows: No. 3340 "15-2 Brassica"; No. 3342 "15-2 Brassica? glandulae in paucis floribus"; and No. 3344 "15-2 Brassica campestris". The latter number is a mixture and does, in fact, have one plant of *Brassica campestris* on the sheet.

Rorippa mexicana (Moc. & Sessé). Standl. & Steyermark, Field Mus. Bot. 23:54. 1944, based on *Nasturtium mexicanum* Moc. & Sessé in DC., Reg. Veg. Syst. Nat. 2: 193. 1821. cf. also DC., Calques des Dessins de la Flore du Mexique, de Mociño et Sessé, pl. 18. 1874.

This original label of the holotype bears the number 15-2 and the name *Sisymbrium amphibium*. There is no other information except the later assigned number 3351. The

FIG. 1. Rorippa pinnata (Sessé & Mociño) Rollins. A — habit sketch x ½; B — flower x 10; C — replum x 3; E — seeds x 10. Drawings from *Pringle* 3552 by C. S. Tsao.

holotype compares favorably with a tracing of the original illustration cited by DeCandolle at the time of the first publication of *Nasturtium mexicanum*, where "Moc. Sess. & Cerv." are cited as the authors of these Mexican Icones. In later publications, DeCandolle referred only to "Moc. & Sesse" as the authors of the same unpublished work. I have followed the more recent practice, which is to attribute *Nasturtium mexicanum* to Mociño and Sessé.

Rorippa mexicana is nearest related to *R. Walteri* of southeastern United States. Its geographical range appears to be from Chihuahua southward in the plateau area of Mexico to Costa Rica. However, a thorough study of *Rorippa* in Mexico needs to be made, not only to accurately determine identities but also to properly ascertain the range of variation within each species.

Sessé and Mociño did not use the name *Nasturtium mexicanum* in their own publications on the flora of Mexico.

Rorippa pinnata (Sessé & Mociño) Rollins, comb. nov., based on *Arabis pinnata* Sessé & Moc. La Naturaleza, ser. 2, 1; appendix p. 104. 1889. The name *Arabis pinnata* has been very much of a puzzle up to the present because the original description associated with it was much too terse to offer any good clues as to what genus the plants described were certainly referable. I had always assumed that at least a plant with linear siliques was the basis for the name. However, with the Sessé and Mociño holotype in hand, the name can at last be settled. The original label data corresponds very closely with the published habitat notes and there is no question but that the specimen under study is the type. The original label reads, "15-2 Arabis pinnata N. Habitat ad margines rivulorum Guaunahuacae". The newly assigned number is 3345.

Most of the specimens of *Rorippa pinnata* in the Gray Herbarium have been undetermined or referred to *R. mexicana*. The following Mexican collections belong to *R. pinnata*: Valley of Mexico. Federal Dist., 6 Nov., 1902, *Pringle 11328;* same locality, 27 Aug., 1890, *Pringle 3552;* same locality, 3 June, 1896, *Pringle 6302;* Canal de Santa Anita,

near Mexico, 25 April [1863-66] *Bourgeau 16;* Crucero-Agua Blanca, Temascaltepec, 9 Nov., 1935, *G. B. Hinton 8329*. Fig. 1.

Following are the names of Cruciferae found in Plantae Novae Hispaniae and Flora Mexicana:

Arabis pinnata (Pl. Nov. Hisp. 104; ed. 2, 97) = **Rorippa pinnata** (Sessé and Mociño) Rollins.

Brassica campestris (Fl. Mex. 168; ed. 2, 154) = **B. campestris** L. mixed with **Romanschulzia arabiformis** (D C.) Rollins.

Brassica chinensis (Pl. Nov. Hisp. 105; ed. 2, 98), specimen unknown.

Brassica eruca (Pl. Nov. Hisp. 105; ed. 2, 98) = **Eruca sativa** Gars. mixed with **Nasturtium Gambelii** (Wats.) Schulz.

Brassica napus (Pl. Nov. Hisp. 104; ed. 2, 97), specimen unknown.

Brassica oleracea (Pl. Nov. Hisp. 104; ed. 2, 98), specimen unknown.

See above for the identities of three sheets which bear the generic name *Brassica* on old labels.

Bunias orientalis (Fl. Mex. 168; ed. 2, 153) = **Draba jorullensis** H. B. K.

Cheiranthus cheiri (Pl. Nov. Hisp. 104; ed. 2, 97), specimen unknown.

Cheiranthus incanus (Pl. Nov. Hisp. 104; ed. 2, 97), specimen unknown.

Clipeola mexicana (Pl. Nov. Hisp. 104; ed. 2, Clypeola 97) = **Lepidium virginicum L.**

Coclearia coronopus (Pl. Nov. Hisp. 104; ed. 2, Cochlearia 97), specimen unknown.

Hesperis matronalis (Pl. Nov. Hisp. 104; ed. 2, 97), specimen unknown.

Lepidium iberis (Fl. Mex. 168; ed. 2, 153), specimen unknown.

Lepidium latifolium (Pl. Nov. Hisp. 104; ed. 2, 97), specimen unknown.

Lepidium ruderale (Fl. Mex. 168; ed. 2, 153) = **Lepidium sordidum** Gray.

Raphanus raphanistrum (Pl. Nov. Hisp. 105; ed. 2, 98) = **Cakile lanceolata** (Willd.) Schulz.

Raphanus sativus (Pl. Nov. Hisp. 105; ed. 2, 98), specimen unknown.

Sinapis arvensis (Pl. Nov. Hisp. 105; ed. 2, 98), specimen unknown.

A sheet with the name "Synapis" is *Brassica nigra* but it does not bear any marks or information that would fix it as the basis for the report of *S. arvensis.*

Sisymbrium indicum (Pl. Nov. Hisp. 105; ed. 2, 98), specimen unknown.

Sisymbrium sophia (Pl. Nov. Hisp. 105; ed. 2, 98), specimen unknown.

Turritis hirsuta (Fl. Mex. 168; ed. 2, 154), specimen unknown. There are two sheets in the collection marked "Turritis?", but these could scarcely be the basis for the report of *T. hirsuta*. One is *Halimolobos polyspermus* and the other is *Pennellia longifolia*. — GRAY HERBARIUM OF HARVARD UNIVERSITY.

PLANT LISTS ARE WHERE YOU FIND THEM: A LIST OF LOCAL FLORAS OF MASSACHUSETTS PUBLISHED SINCE 1898.

STUART K. HARRIS

In an article on "Wild Flower Identification" which appeared in Massachusetts Audubon for March-April 1958 the statement was made, "Local lists are rare." This raised my hackles, for the New England area, and particularly Massachusetts, is probably better provided with local lists of plants than any region of comparable size in the United States. I know of three[1] important bibliographies of local floras. NATHANIEL LORD BRITTON, 1890: a list of state and local floras of the United States and British America. Annals N. Y. Acad. Sci. 5: 237-299 covers the period up to May 1890 and contains 45 items for Massachusetts. MARY A. DAY, 1899, 1900: the local floras of New England. Rhodora 1: 111-120, 138-142, 174-178, 194-196, 208-211 and 2: 254-257 includes items up to 1 January 1899 and contains 95 titles for Massachusetts. FRANK E. EGLER, 1950: regional vegetation literature III. Massachusetts. Phytologia 3: 193-237 is the most recent but has a somewhat broader coverage, including vegetational as well as floristic papers.

In the present list I have attempted to include papers which have appeared since the publication of Miss Day's list plus a few additions and corrections to that list. I am sure that my series is not complete but I think that it includes most of the major floras as well as a few very minor ones. Most of the items have been seen by me but a few titles are taken from a variety of sources. I have also included a number of short notes adding species to published floras. It is difficult to know exactly where to draw the line

[1] In addition to the standard list of floras by S. F. Blake and Alice C. Atwood, Geographical Guide to Floras of the World, U. S. Dept. of Agric. Misc. Publ. 401. 336 pp. 1942.

and a few items are included for whimsical rather than scientific reasons. The list begins with a general section which contains papers dealing with more than one county; county sections follow.

While many of the items have appeared in books or in well-known journals, others turn up in the strangest places; hence the title of the paper. Some have appeared spasmodically in local newspapers, others in annual reports of town departments or local societies and many are tucked away in town histories. The authors grade all the way from trained botanists of world-wide reputation to the rankest of amateurs, in one case a sophomore in high school. While the value of the lists varies greatly some useful information can be gleaned from most of them.

GENERAL

BLANKINSHIP, J. W. 1903. The plant formations of eastern Massachusetts. Rhodora 5: 124-127.

BROWN, ABBIE FARWELL 1900. Notable trees about Boston. New Eng. Mag. 22: 503-523.

CLARK, DANIEL ALLEN 1907. Forest trees of Massachusetts. 67 pp. Wright & Potter, Boston. Other editions through 1916.

COOK, H. O. 1931. Original forests of Cape Cod. Jour. Forestry 29: 422, 423.

FERNALD, MERRITT LYNDON 1910. Notes from the Phaenogamic Herbarium of the New England Botanical Club, — I. Some local plants of eastern and central Massachusetts. Rhodora 12: 185-192.

1924. Key to the families of spring-flowering plants of eastern Massachusetts. 12 pp. Harvard University, Cambridge.

GOODALE, ALFRED SHEPARD 1935. A check list of the Gymnospermae occurring in the Connecticut River Watershed in Massachusetts. 4 pp.

HARPER, ROLAND MCMILLAN 1900. Further additions to the flora of the Amherst region. Rhodora 2: 68-70.

1900. Notes on the distribution of some of the rarer plants of central Massachusetts. Rhodora 2: 119-123.

1905. Coastal Plain plants in New England. Rhodora 7: 69-80.

1906. Further remarks on the Coastal Plain plants of New England, their history and distribution. Rhodora 8: 27-30.

HOLLICK, ARTHUR 1902. Geological and botanical notes: Cape Cod and Chappaquidick Island, Massachusetts. Bull. N. Y. Bot. Gard. 2: 381-407.

ILLICK, JOSEPH S. 1927. Common trees of Massachusetts. 110 pp. American Tree Association, Washington.

KNOWLTON, CLARENCE HINCKLEY The earliest spring flowers. 2 pp. South Shore Nature Club Leaflet #3.

1907. Newly observed stations for Massachusetts plants. Rhodora 9: 11-15.

1929. Index to the Flora of the Boston District. Rhodora 31: 41-43.

1930. The goldenrods of the Massachusetts South Shore. South Shore Nature Club.

1931. The asters of the Massachusetts South Shore. South Shore Nature Club.

1933. Trees of the Massachusetts South Shore. South Shore Nature Club.

1944. Shrubs and vines of the Massachusetts South Shore. 20 pp. South Shore Nature Club.

1949. Plant societies of south-eastern Massachusetts. 10 pp. South Shore Nature Club.

LOCKE, ELSIE 1902. Flower folk in the Boston Reservations. New Eng. Mag. 26: 259-267.

MANNING, WAYNE E. 1937. New records for the Connecticut Valley in Massachusetts. Rhodora 39: 186-188.

MAYHEW, INEZ P. 1920. Winter flowers in Massachusetts. Amer. Bot. 26: 140, 141.

MOLDENKE, HAROLD N. 1945. A contribution to our knowledge of the wild and cultivated flora of Massachusetts, — I. Torreya 45: 41-52.

NEW ENGLAND BOTANICAL CLUB 1907-1924. Flora of the Boston District. Rhodora 9-26. This work which appeared in forty-nine parts scattered over eighteen years is by far the most important flora in the list. The Boston District includes Essex County; Suffolk County; Norfolk County; all of Middlesex County except Shirley, Pepperell, Townsend and Ashby; Southborough in Worcester County; Mansfield and Easton in Bristol County and Plymouth County south through West Bridgewater, East Bridgewater, Hanson, Pembroke and Duxbury.

1910. Plants of eastern Massachusetts flowering in April 1910. Rhodora 12: 127-129.

1928-1947. Reports on the flora of Massachusetts. Rhodora 30-49. This started out to be a state flora but unfortunately only four parts were issued which cover the Pteridophyta through the Gramineae. There is little prospect that additional parts will appear in the near future.

SIMMONS, JAMES RAYMOND 1919. Historic trees of Massachusetts. 139 pp. Marshall Jones, Boston.

STONE, GEORGE E. 1899. Past and present floral conditions in central Massachusetts. Rhodora 1: 143-148.
1907. Massachusetts weeds. 8 pp. Mass. State Board Agr. Nature Leaflet #20.
1913. A list of plants growing without cultivation in Franklin, Hampshire and Hampden Counties, Massachusetts. 72 pp. Carpenter & Morehouse, Amherst.
WAUGH, FRANK A. AND CHARLES H. THOMPSON 1930. Hardy woody plants. Mass. Agr. Exp. Sta. Bull. #267: 146-182.

BARNSTABLE COUNTY

BARTLETT, HARLEY HARRIS 1908. The submarine Chamaecyparis bog at Woods Hole, Massachusetts. Rhodora 11: 221-235.
CHENEY, CLARA IMOGENE 1902. Rare plants in Centerville, Massachusetts. Rhodora 4: 245, 246.
1904. Plants from Cape Cod. 19 pp. Boston.
CLARK, HUBERT LYMAN 1901. Notes on the flora of Woods Hole, Massachusetts. Rhodora 3: 87-89.
COLLINS, FRANK SHIPLEY 1909. Notes on the flora of lower Cape Cod. Rhodora 11: 125-133.
1910. Flora of lower Cape Cod; supplementary note. Rhodora 12: 8-10.
1911. Flora of lower Cape Cod; third note. Rhodora 13: 17-22.
1915. November flowers. Rhodora 17: 33-38.
DEANE, WALTER 1889. A few Cape Cod plants. Bot. Gaz. 14: 45-47.
FOGG, JOHN MILTON, JR. 1930. A few noteworthy plants from Falmouth, Massachusetts. Rhodora 32: 103-111.
HARPER, ROLAND MCMILLAN 1921. Cape Cod vegetation. Torreya 21: 91-98.
KNOWLTON, CLARENCE HINCKLEY 1914. The original flora of the Old Colony. Rhodora 16: 113-116.
SINNOTT, EDMUND W. 1912. The pond flora of Cape Cod. Rhodora 14: 25-34.

BERKSHIRE COUNTY

ANDREWS, A. LEROY 1900. Orchids of Mt. Graylock, Massachusetts. Rhodora 2: 179, 180.
ADAMS, JOHN COLEMAN 1901. Nature studies in Berkshire. 225 pp. Putnam, N. Y.
BAILEY, S. WALDO AND HERBERT J. ARNOLD 1957. Bartholomew's Cobble, Sheffield, Massachusetts. 32 pp. Trustees of Reservations. The plant list is based on the work of Charles Alfred Weatherby.
HOFFMAN, RALPH 1904. Notes on the flora of Berkshire County, Massachusetts. Rhodora 6: 202-206.
1922. Flora of Berkshire County, Massachusetts. Proc. Boston Soc. Nat. Hist. 36: 171-382.
——————— AND G. THOMPSON 1914. Notes on Stockbridge trees. Stockbridge 1: 8-11.

KNOWLTON, CLARENCE HINCKLEY 1919. An excursion to Mt. Washington, Massachusetts, and Bash-Bish Falls. Rhodora 21: 198-202.
NILES, GRACE GRAYLOCK 1905. Hoosac Valley and its flowers and ferns. Amer. Bot. 9: 1-7, 21-28.
SIMPSON, A. KENNETH 1948. With what the hills are clothed. pp. 31-74 in Roderick Peattie The Berkshires, the purple hills. Vanguard, N. Y.
WALLACE, GEORGE JOHN 1939. Some recent additions to the flora of Berkshire County, Massachusetts. Rhodora 41: 128-130.
1942. More Berkshire plants. Rhodora 44: 332-334.
WEATHERBY, CHARLES ALFRED 1947. Bartholomew's Cobble. Amer. Fern Jour. 37: 1-6.
WHIPPLE, REV. A. B. 1892. The early botany of Berkshire. pp. 5-35. Berkshire Historical and Scientific Society.

BRISTOL COUNTY

HERVEY, E. WILLIAMS 1911. Flora of New Bedford and the shores of Buzzards Bay with a procession of the flowers. Revised edition. 137 pp. E. Anthony & Sons, New Bedford.

DUKES COUNTY

FOGG, JOHN MILTON, JR. 1930. Flora of the Elizabeth Islands, Massachusetts. Rhodora 32: 119-132, 147-161, 167-180, 208-221, 226-258, 263-281. Also as Cont. Gray Herb. of Harvard Univ. #41.
FORBES, SARAH SWAIN 1905 The botany of Naushon. 114 pp. Privately printed. Geo. H. Ellis Co., Boston.
HOLLICK, ARTHUR 1893. Observations on the geology and botany of Martha's Vineyard. Trans. N. Y. Acad. Sci. 13: 8-22.
1901. A reconnaissance of the Elizabeth Islands. Annals N. Y. Acad. Sci. 8: 387-418.
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MELENEY, GRACE COIT 1931. Flora of the Island (Martha's Vineyard), long list of plants collected here last July. Vineyard Gazette August 7.
MOUL, EDWIN T. 1948. Flora of Penikese Island. In Maxwell S. Doty et al. The flora of Penikese, seventy-four years after. Rhodora 50: 288-304.

ESSEX COUNTY

BARTLETT, MIRA W. 1924. Ferns (A list of the native ferns found growing in Haverhill.) Bull. Haverhill Public Library 8: 17-19.
1925. A partial list of the wild flowers found growing in the thirty-two square miles comprised in the city of Haverhill. Bull. Haverhill Public Library 8: 61-76.
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GRAYCE, ROBERT L. 1952. Cape Ann forests, a review. Essex Inst. Hist. Coll. 88: 207-218.

HAVERHILL AGASSIZ ASSOCIATION 1900. A partial list of the wild flowers and ferns which may be found in Winnekeni Park, pp. 8-14. Ann. Report Park Commissioners of the City of Haverhill, Mass., for the year ending December 31, 1900.

HORNER, CHARLOTTE NICHOLS SAUNDERS 1876. List of plants of Georgetown and its vicinity. Georgetown Advocate 2: Feb. 26, Mar. 11, 18, Apr. 1, 29, May 20.

MOORE, ARTHUR HANFORD AND ARTHUR STANLEY PEASE 1902. List of plants introduced into Andover, Massachusetts in 1902. 7 pp. Privately Printed.

PEASE, ARTHUR STANLEY 1901. Some wild flowers of Andover. 31 pp. School Dept., Andover.

ROBINSON, JOHN 1926. Plants growing the first season in an uncovered cellar. Rhodora 28: 69-74. Written October 1, 1908 and published posthumously.

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(SPENCER, THOMAS) An English Resident 1849. Vegetation about Salem, Massachusetts. Pp. 224-245 in Elizabeth P. Peabody Aesthetic Papers. Putnam, N. Y.

TOWNSEND, CHARLES W. 1925. Sand Dunes and Salt Marshes. 311 pp. Page, Boston.

WENTWORTH, L. A. 1905. The flora of Lynn Woods. Pp. 41-58 in 16th Ann. Rep. Park Commissioners, Lynn, Mass., for 1904.

WHITTIER, JOHN GREENLEAF 1863. Flowers, flowering shrubs and vines in Amesbury and Salisbury. Proc. Essex Inst. 3: 271. A brief and amateurish list but an interesting author.

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FRANKLIN COUNTY

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OWEN, MARIA L. 1901. Ferns of Mount Toby, Massachusetts. Rhodora 3: 41, 42.

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HAMPDEN COUNTY

ANDREWS, LUMAN 1924. Catalogue of the flowering plants and ferns of Springfield, Massachusetts. 321 pp. Bull. #3. Museum Nat. Hist. Springfield.

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HAMPSHIRE COUNTY

CLARK, HUBERT LYMAN 1899. Additions to the flora of Amherst, Massachusetts. Rhodora 1: 164, 165.

JUDD, SYLVESTER 1905. A list of the plants of Hadley. Pp. 426-429 in the History of Hadley. Huntting, Springfield.

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MIDDLESEX COUNTY

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1958. The spontaneous flora of an old house-lot in eastern Massachusetts. Rhodora 60: 61-73.

HILL, ELIZABETH SEWALL. 1912. Flora (Groton). Pp. 1-26 of Vol. I. in Samuel Abbott Green The Natural History and the Topography of Groton, Massachusetts. Groton.

(HOSMER, ALFRED W.) 1899. On the plants introduced by Minot Pratt at Concord, Massachusetts. Rhodora 1: 168-172.

1899. Further additions to the flora of Middlesex County, Massachusetts. Rhodora 1: 223, 224.

KNOWLTON, CLARENCE HINCKLEY 1912. Rare plants in Groton, Massachusetts. Rhodora 14: 234, 235.

1917. The botany of Chelmsford. Pp. 651-655 in Wilson Waters History of Chelmsford. Published by the town.

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RICE, MABEL AGNES 1946. Trees and shrubs of Nantucket. 77 pp. Natural Science Dept., The Maria Mitchell Association, Nantucket.

SHURROCKS, ALICE ALBERTSON 1958. A grain of mustard seed. 245 pp. Reynolds-Dewalt, New Bedford. The title hardly indicates that this is the most recent flora of Nantucket and the newest of this list.

SMITH, SARA WINTHROP 1901. Nantucket A brief sketch of its physiography and botany. 24 pp. Knickerbocker Press, N. Y.

WILSON, ANNE 1908. Boggy solitudes of Nantucket. 118 pp. Neale, N. Y. & Wash.

NORFOLK COUNTY

CLARK, ARTHUR 1902. A few plants of the Blue Hills Reservation. Rhodora 4: 74-76.

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PLYMOUTH COUNTY

HEDGE, CATHERINE ELLIOT 1904. Wild flowers of Plymouth and vicinity 1804-1904. 46 pp. Geo. H. Ellis, Boston.

KNOWLTON, CLARENCE HINCKLEY 1912. Notes of the flora of Duxbury, Massachusetts. Rhodora 14: 18-22.

1924. Notes on the plants of Hingham, Massachusetts. Rhodora 26: 175-177.

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MAY, JOHN B. 1912. Further notes on the flora of Duxbury, Massachusetts. Rhodora 14: 90, 91.

MORRIS, JAMES J. 1918. The forests of Plymouth County. 148 pp. State Forester, Boston.

SUFFOLK COUNTY

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1908. City botanizing (Boston). Rhodora 10: 149-155.

WORCESTER COUNTY

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NOTE ON ELAEAGNUS COMMUTATA. — The name *Elaeagnus commutata* appeared first in Allg. Thüring. Gartenzeit. 2: 95. 1843, without a description. Subsequently this name was validated by Mansfeld in Fedde's Repertorium Specierum Novarum Regni Vegetabilis 47: 280. 1939 with the description of P. A. Rydberg in his Flora of the Prairies and Plains of North America 563. 1932. Unfortunately, Mansfeld overlooked the earlier identical description of Rydberg in Flora of the Rocky Mountains and Adjacent Plains 582. 1918 [1917]. The correct citation, published in his Flora of the Rocky Mountains and Adjacent Plains 582. 1918 [1917], should read *Elaeagnus commutata* Bernhardi ex Rydberg. — BURDETTE L. WAGENKNECHT, ARNOLD ARBORETUM.

Volume 61, number 732, including pages 297-324, was issued January 19, 1960.

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JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

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Vol. 62 February, 1960 No. 734

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

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Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

Rhodora

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NEW ENGLAND BOTANICAL CLUB

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CHROMOSOME NUMBERS IN SOME AMERICAN FARINOSE PRIMULAS WITH COMMENTS ON THEIR TAXONOMY[1]

H. W. Vogelmann

The genus *Primula* presents interesting cytotaxonomic problems. Comprised of a number of both disputed and confusing species, the genus is a classical example of the utility of chromosome number determinations in elucidating species relationships. Bruun (1930, 1932) in an extensive cytological study of *Primula*, found that the subsection *Eu-Farinosae* is characterized by a basic number of x = 9 and that among its Eurasian species there occurred chromosome levels of 2x, 4x, 6x, 8x, and 14x. A separate subsection, proposed by Bruun (1932) on the basis of its cytological distinctness, includes several species with the basic number of x = 8.

The published data on the cytology of the American farinose primulas are scanty. And this has largely been obscured because reported chromosome number determinations for native species have been merely included in papers in which investigations other than cytological have been emphasized (Bruun, 1938; Thomas, 1951). It is my purpose here to summarize the available information as to chromosome counts for the American farinose species and to report my own cytological findings.

1 Some of the data reported here are included in a dissertation entitled, "A Biosystematic Study of *Primula mistassinica* Michx.", which was submitted by the author to the University of Michigan in partial fulfillment of the requirements of the Degree of Doctor of Philosophy.

I am indebted to Drs. Doris and Askell Löve of the Botanical Institute of the University of Montreal for providing me with unpublished data. In particular I wish to express my appreciation to Dr. Askell Löve and Dr. Alexander Gershoy of the Botany Department of the University of Vermont for reading the manuscript and offering many helpful suggestions and comments.

SOURCE OF MATERIALS AND METHODS

The plants used for the present study were obtained either from germinated seeds taken from herbarium specimens or from living individuals transplanted to the greenhouse from their native habitat. All specimens were grown at the Botanical Garden of the University of Michigan during the years 1954 and 1955. This provided the opportunity to compare the morphological variations of plants in the greenhouse growing under uniform conditions which helped to interpret variations found in the field. Whenever plants found widely separated geographically, or plants within a particular population at a given site, showed obvious phenotypic differences these were carefully examined cytologically to determine whether correlated karyotypic differences also occurred. Voucher specimens were made of the experimental plants and these, together with the author's field collections are housed in the Pringle Herbarium of the University of Vermont.

Comparatively large collections were made of both *P. mistassinica* Michx. (including *P. intercedens* Fern.) and *P. laurentiana* Fern. Representatives of 16 populations of *P. mistassinica* covering much of its range in eastern North America were studied cytologically. Plants of *P. laurentiana* were also examined from collections taken from 9 stations in the Gaspé Peninsula and in Newfoundland.

Chromosome determinations were made mainly from root tips by use of the acetocarmine squash technique, after preliminary fixation in chloroform-ethanol-acetic acid (4:3:1).

OBSERVATIONS

Primula mistassinica Michx. is a widely distributed species in boreal North America found growing in a variety of calcareous habitats including wet sedgy or mossy sites, stony or marly lake shores, and on shaded wet ledges or faces of

cool bluffs. Root tip squashes from all plants investigated had a chromosome number of $2n = 18$ (Figs. 1-9). Table 1 shows the localities from which material was obtained. Chromosome numbers were constant regardless of geographical location or differences in habitat. Superficially the chromosomes appeared alike in size and shape in all plants examined.

Pronounced variation in leaf size, shape, and degree of farinosity was observed among the cultivated plants, this being particularly true for representatives from the Great Lakes region. Some individuals could well be assigned to *Primula intercedens* Fern., which Fernald (1928) described as endemic to the upper Great Lakes region. Selected plants showing extremes of all variations were carefully studied in an attempt to detect cytological differences and none was found.

The question of validity of *Primula intercedens* as a good species will be the subject of a forthcoming paper; however it is here advisable to make a few comments about this species in order to clarify its treatment in the present investigation. Fernald (1928) separated *Primula intercedens* from *Primula mistassinica* pointing out that the former had yellow-farinose leaves and calyces, and angulate, truncated, and strongly rugose seeds. According to Fernald, *Primula mistassinica* is generally efarinose with rounded and smooth seeds. Hesitant about the validity of his newly described species he adds (Fernald, 1928, p. 87), "*P. intercedens* is here proposed without full confidence of its specific value; but it seems most likely that, in the upper Great Lake region, where it occurs in the same areas as typical *P. mistassinica*, the two have become much crossed." Other taxonomists have indicated their difficulty in separating the two presumed taxa (Butters & Abbe 1953) and a few chose not to recognize the specific status of *P. intercedens* (Brown, 1937; Gleason, 1952). The present author's investigations based on field and transplanted populations, supplemented by herbarium specimens, fail to substantiate any consistent morphological differences between the two species. Since the present cytological study also fails to reveal karyological differences the present writer includes in the variable *P. mistassinica* complex the plants assigned to *P. intercedens*.

TABLE 1. Chromosome numbers of P. mistassinica

Species	*Locality*	*2n*
P. mistassinica Michx., var. mistassinica f. mistassinica (including P. intercedens Fern.)	MICHIGAN:	
	Cheboygan Co.: Grass Bay (Vogelmann 547 VT).	18
	Presque Isle Co.: Hammond Bay (Vogelmann 548 VT).	18
	Emmet Co.: Little Traverse Bay (Vogelmann 541 VT).	18
	Mackinac Co.: S. Gould City (Vogelmann 545 VT)	18
	Hog Island Creek (Vogelmann 544 VT)	18
	Davenport Creek (Vogelmann 546 VT)	18
	Alger Co.: Pictured Rocks (Vogelmann 549 VT)	18
	Miner's Falls (Vogelmann 533 VT)	18
P. mistassinica var. mistassinica f. leucantha Fern.	QUEBEC:	
	East Gaspé Co.: Percé (Vogelmann 654 VT)	18
	NOVA SCOTIA:	
	Victoria Co.: Cape North Village (Smith, et. al. 3750 MT)	18
	NEWFOUNDLAND:	
	St. Georges Port-Au-Port Distr.: Green Head (Rouleau 3709 MT)	18
	St. Barbe Distr.: Bonne Bay (Rouleau 3334 MT)	18
	Humber Distr.: Serpentine River (Rouleau 1865 MT)	18
	White Lake (Rouleau 2041 MT)	18
P. mistassinica var. noveboracensis Fern.	MICHIGAN:	
	Eaton Co.: Grand Ledge (Vogelmann 617 VT)	18
	NEW YORK:	
	Tompkins Co.: Taughannock Creek (Vogelmann 616 VT)	18

Primula laurentiana Fern., a quite robust species, is found in the Gaspé Peninsula, Newfoundland, and on the north shore of the St. Lawrence River where it usually grows on calcareous slopes or ledges. A list of localities from which specimens of *Primula laurentiana sensu str.* were obtained for chromosome counting is given in Table 2. The eight

populations studied, including transplants and plants grown from seeds, were octoploids, 2n = 72 (Fig. 10). Several meiotic figures, obtained from an anther squash of a plant from St. Barbe District, Newfoundland, showed good pairing (Fig. 13).

A single population, collected from "grassy talus slopes" between Chimney Cove and Shoal Point, in the Humber District of western Newfoundland, grown from seeds of plants collected by Dr. Ernest Rouleau (No. 3405), on deposit in the Marie-Victorin Herbarium of the University of Montreal, was found to have 2n = 54 (Fig. 11). Phenotypically these plants fell within the range of variation found in *P. laurentiana;* however, detailed examinations designed to clearly separate the "grassy talus" hexaploids from the groups of octoploids were not made in the present study.

TABLE 2. Chromosome numbers of P. laurentiana. s. str.

Species	*Locality*	*n*	*2n*
P. laurentiana Fern.	QUEBEC:		
	Rimouski Co.: Rimouski (Raymond and Kucyniak 1673 MT)		72
	West Gaspé Co.: Tourelles (Pere Louis-Marie and R. Cayouette 50183 MT)		72
	NEWFOUNDLAND:		
	St. Barbe Distr.: Bonne Bay (Rouleau 3320 MT)	36	72
	Humber Distr.: s. of Chimney Cove (Rouleau 1374 MT)		72
	n. e. of Serpentine River (Rouleau 1785 MT)		72
	s. w. of Black Head (Rouleau 1612 MT)		72
	Weebald (Rouleau 1576 MT)		72
	Big Island Cove (Rouleau 1300 MT)		72

Primula incana Jones. The widely ranging species, *Primula incana* Jones, is found growing in wet, calcareous, subalpine meadows of the Rocky Mountains. From transplants of *P. incana* collected in a wet meadow near Jefferson, Colorado, a definitive root tip chromosome count of 72 was obtained

(Fig. 14.) The chromosomes of this octoploid species appear slightly smaller than those found in octoploid *P. laurentiana* and decidedly smaller than those of the diploid *P. mistassinica.*

Primula specuicola Rydb. shows an unusual site preference within the arid regions of southeastern Utah and Arizona. Typically it inhabits the moist, shaded walls of shallow caves found in calcareous sandstone cliffs. Plants of this species are quite large, both upper and lower leaf surfaces being densely covered with whitish farina. Cytological studies indicate that it is a diploid.

The differences between the diploid *P. specuicola* and *P. mistassinica* emphasize striking dissimilarities in vegetative and floral structures. However, *P. specuicola* like *P. mistassinica* produces heterostyled flowers, a phenomenon which seems to be common among diploids but not polyploids of this section as stressed by Ernst (1953).

Primula hunnewellii Fern., described by Fernald (1934) from collections made on the limestone cliffs of the North Rim of the Grand Canyon, Coconino Co., Arizona, differed from *P. specuicola* in having a much smaller calyx and an exserted capsule. It is of interest that Kearney and Peebles (1942, p. 666) list it as a questionable synonym of *P. specuicola* stating that the "type of the doubtfully distinct *P. hunnewellii* also from the Grand Canyon". The present author's observations tend to support this interpretation since he found both exserted and included capsules among a number of plants from a single population near Bluff City, Utah (type locality for *P. specuicola*). The size of the calyces among these plants was variable, none being found as small as Fernald recorded for *P. hunnewellii.*

A summary of the known chromosome numbers in the North American farinose primulas is given in Table 3. Ernst (1953) has presented a chart showing the "ploid" levels for seven American species of the subsection *Eu-Farinosae* in which the Alaskan *Primula borealis* is given as a diploid, and *P. incana* is indicated as an octoploid. Bruun's cytological work is cited by Ernst as the basis for his list. Regrettably it is not clear to the present author whether the "n" counts which Bruun (1938, p. 252) gives in parentheses

after *P. mistassinica* and *P. laurentiana* are also intended to apply to those species which precede them in his listing.

TABLE 3. Chromosome numbers of some North American primulas in the subsection Eu-Farinosae

Species	*n*	*2n*	*Reported by*
P. borealis Duby		18	Thomas (1951)
P. incana Jones		72	Vogelmann
P. laurentiana Fern. s. lat.	36		Brunn (1938), Vogelmann
		72	Vogelmann
		54	Vogelmann
P. mistassinica Michx.	9		Bruun (1938)
var. mistassinica f. mistassinica (incl. P. intercedens Fern.)		18	Vogelmann
var. mistassinica f. leucantha Fern.		18	Vogelmann
var. noveboracensis Fern.		18	Vogelmann
P. specuicola Rydb.		18	Vogelmann
P. stricta Hornem. (det. on Swedish and Icelandic plants and from Churchill, Manitoba)		126	Bruun (1930, 1932) Löve and Löve (1956 and unpublished)

DISCUSSION

The widespread native diploid species, *P. mistassinica*, is considered here to be the North American counterpart of the widespread Eurasian diploid *P. farinosa*. This idea is given support not only by the chromosome number common to both species but also by the close phenotypic similarity to *P. farinosa* which exists among some of the plants in the variable *P. mistassinica* complex. Generally, plants of *P. mistassinica* are slender and efarinose yet some individuals, particularly those growing on calcareous sandstone ledges in the Great Lakes region, are difficult if not impossible to distinguish from certain plants of *P. farinosa*. Hybridization studies are needed to establish indices of crossability and fertility.

Where the northwestern range of *P. mistassinica* ends, the range of *P. borealis* begins (see maps in Hultén 1948, p. 1336). This Alaska and Yukon species has also proven to be diploid (Thomas, 1951). Even if these species are not

conspecific they are certainly closely related as is evidenced by phenotypic characters found in common and by chromosome morphology.

Phenotypic similarities between the octoploids *P. laurentiana* and *P. incana* have already been recognized (Hultén, 1948; Fernald, 1928). *P. scandinavica* of Europe, also an octoploid species, may well be a near relative of our North American taxa. Such herbarium specimens as have been available indicate similarities to *P. laurentiana*.

Still another octoploid, *P. decipiens*, grows in the southern cordillera in South America (Bruun, 1930, 1932). This species bears more similarity to *P. incana* of the Rocky Mountains than any other species, a fact noted by Fernald (1928, p. 74) who stated: "In its subcapitate inflorescence and plane bracts *P. incana* is nearer related to *P. decipiens* of southern South America (*P. magellanica* of authors) than to other members of the *Farinosae*". Bruun (1932) also points out that the chromosomes of the octoploid *P. decipiens* are three-fourths as long as *P. farinosa* which ratio is similar to the size relationship obtained by this writer in a comparison of *P. incana* and *P. mistassinica*. The smaller chromosome size of both *P. incana* and *P. decipiens* may be a further indication that both species differentiated from a common ancestral stock.

Although the diploids are widespread in Eurasia and North America, it appears that the octoploids and the tetrakaidekaploid (14-ploid) *P. stricta* have been most successful in establishing themselves throughout arctic and mountainous regions generally regarded as having severe environments (Stern 1949). The widespread recurrence of octoploid species, as for example *P. capitellata* in the alpine areas of southern Persia, *P. scandinavica* in Scandinavia,

---

New York (8) 1455X and Grand Ledge, Michigan (9) 970X. FIG. 10. 72 chromosomes of *P. laurentiana* from Bonne Bay, Newfoundland. 1455X. FIG. 11. 54 chromosomes of *P. laurentiana* from between Shoal Point and Chimney Cove, Newfoundland. 1455X. FIG. 12. *P. specuicola* from near Bluff City, Utah. 970X. FIG. 13. 36 bivalents from pollen mother cells of *P. laurentiana* from Bonne Bay, Newfoundland. 970X. FIG. 14. 72 chromosomes of *P. incana* from Jefferson, Colorado. 970X. FIG. 15. *P. borealis*, 2n = 18, drawn from a root tip cross-section prepared by Dr. Henry J. Thompson and provided for publication by Dr. John H. Thomas.

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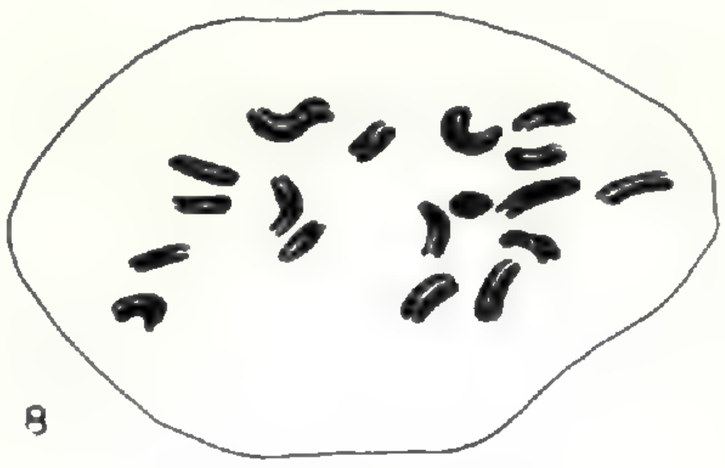
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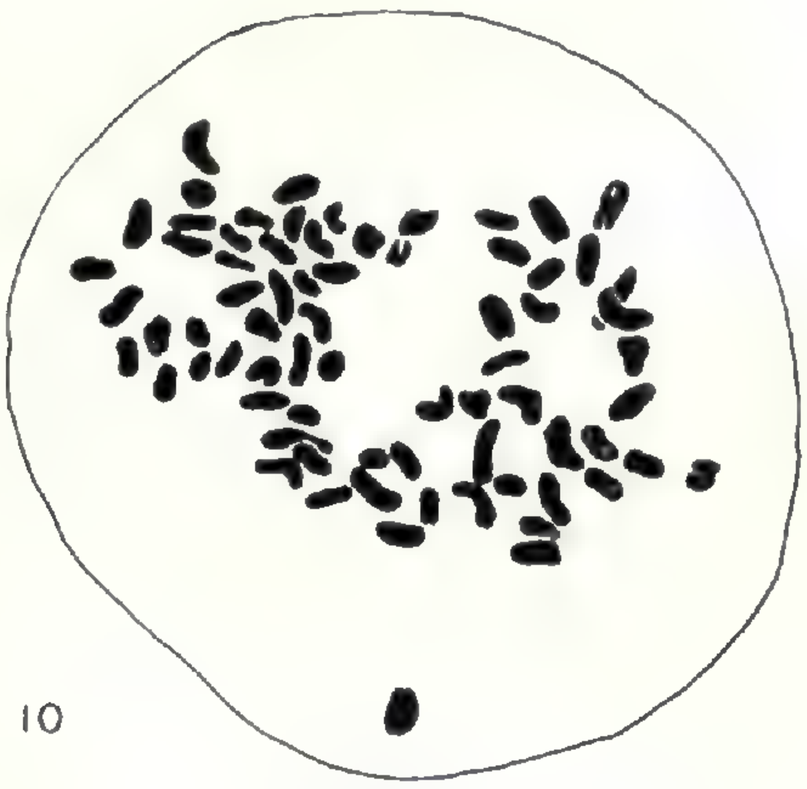
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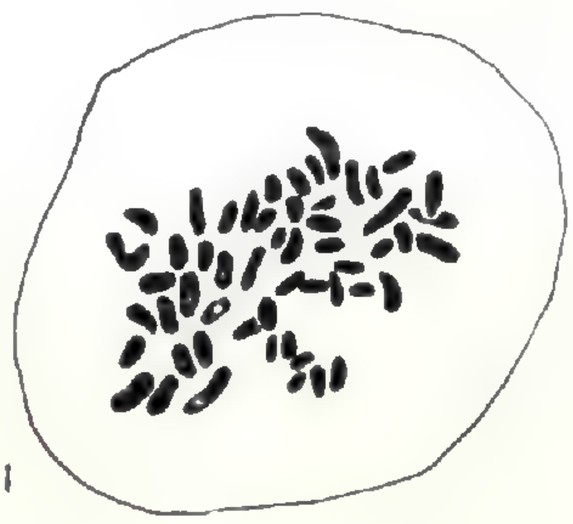
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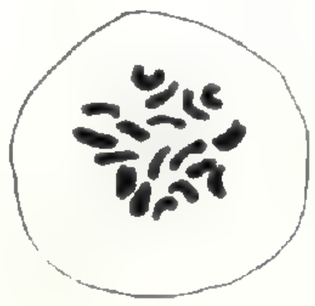
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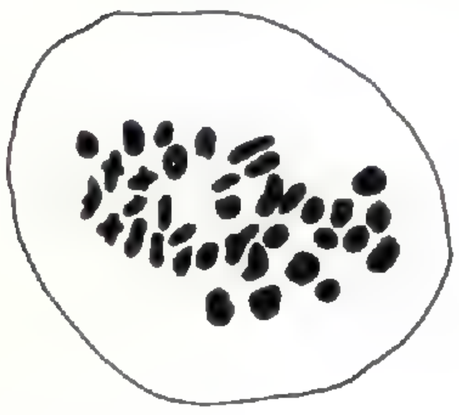
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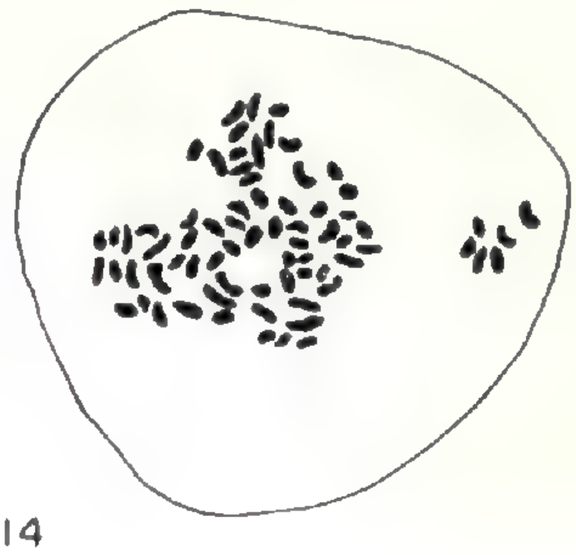
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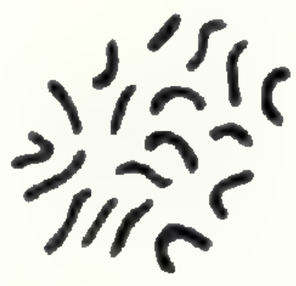
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FIG. 1-14. Chromosomes of several North American primulas of the subsection *Eu-Farinosae*. All figures show root tip chromosomes at somatic metaphase unless otherwise indicated. FIG. 1. *P. mistassinica* from Grass Bay, Michigan. 1455X. FIG. 2. Chromosomes of an exceptionally large plant of *P. mistassinica* from Grass Bay, Michigan. 970X. FIG. 3-6. *P. mistassinica* f. *leucantha* from Newfoundland: Bonne Bay (3) 1455X; Serpentine River (4) 1455X; White Lake (5) 970X; Green Head (6) 1455X. FIG. 7. *P. mistassinica* f. *leucantha* from Cape North Village, Nova Scotia. 1455X. FIG. 8-9. *P. mistassinica* var. *noveboracensis* from Taughannock Creek,

P. laurentiana in Laborador, Nova Scotia, and the Gaspé, *P. incana* in the Rocky Mountains, and *P. decipiens* in the southern Andes, Cape Horn, and the Falkland Islands, may well be an indication of a very old and formerly highly successful complex. The present day discontinuous distribution of these species may, perhaps, indicate fragmentation of a formerly very wide-ranging species by Pleistocene glaciations.

The presence of a hexaploid plant in collections of *P. laurentiana,* sensu lat., in Newfoundland indicates that additional cytological studies are needed to determine whether this chromosome number, unique for this species, is of local or more widespread occurrence and whether there are morphological or ecological characteristics associated with it. When Bruun's (1930, 1932) investigation of the *Farinosae* revealed that the octoploid *P. scandinavica* (then called *P. scotica* var. *scandinavica*) was cytologically and geographically distinct from *P. scotica* (cf. also Dovaston, 1955), he observed dissimilarities in the leaves, scapes and stigmas (Bruun 1938). It should be noted that Smith and Fletcher (1943) are not convinced of the leaf and scape criteria used by Bruun although they do accept the validity of the species.

The relation of *P. specuicola* to other members of the farinose group is not clear. Since it is a diploid (2n = 18), and thereby holds a basic phyletic position, its taxonomic position deserves further investigation. The species does not appear to be closely related to any other American taxa. Rydberg (1913) suggests that it is near *P. farinosa* and *P. incana* and Fernald (1928, p. 86) states that "*P. specuicola* may be nearer related to *P. rusbyi* Greene (2n= 44, Bruun 1932) than to the *Farinosae*". The abundance of farina on the leaves and flowers of *P. specuicola,* combined with the fact that its basic chromosome number of 9, seems to fix the position of this species with the *Eu-Farinosae* complex.

P. specuicola is quite distinct from other species of the section in its ecological preference. Growing on moist calcareous sandstone walls of shallow caves in the arid regions of southwestern United States its habitat displays a striking contrast to that within which most members of the *Farinosae* are found. The latter are usually found at much

higher latitudes and/or altitudes where the macroclimate is considerably cooler and moist. Unquestionably *P. specuicola* is subjected to severe environmental fluctuations such as high temperatures and, perhaps, occasional periods of dryness.

The circumpolar and arctic species, *P. stricta* Hornem., has the highest number reported for the genus, or 2n = 126 chromosomes. This 14-ploid complement has been determined by Bruun (1932) on plants from two localities in Sweden and by Löve and Löve (1956) on material from northern and eastern Iceland. Populations from Churchill in Manitoba, collected and fixed by Dr. J. C. Ritchie of Winnipeg, were found to have the same high chromosome number (Löve and Löve, unpubl.) Thus there are good indications that this high chromosome level is maintained throughout its extensive arctic distribution.

The tendency toward polyploidy well-established among Eurasian species in primulas of the subsection *Eu-Farinosae*, is also revealed in the North American taxa. Thus chromosome levels of 2x, 6x, 8x, and 14x have been found within American species. In view of such data some revision is needed in the map of distribution of "ploid" levels in the *Eu-Farinosae* by Stern (1949), later used by Darlington 1956). The widespread occurrence of diploid and polyploid species in both hemispheres needs to be given serious consideration when evaluating the evolutionary development of the *Eu-Farinosae* complex. Of more general interest, the geographical patterns of "ploid" levels illustrated by this group may contribute to a better understanding of the history and distribution of the circumboreal flora. — UNIVERSITY OF VERMONT.

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THE STATUS OF THE GENERA AMPHIPAPPUS, AMPHIACHYRIS, GREENELLA, GUTIERREZIA, GYMNOSPERMA AND XANTHOCEPHALUM (COMPOSITAE)

OTTO T. SOLBRIG[1]

The taxonomic status of the genera *Amphipappus, Amphiachyris, Greenella, Gutierrezia, Gymnosperma* and *Xanthocephalum*, has been questioned recently by L. Shinners (1950). Since other authors (Torrey and Gray 1841, Bentham and Hooker 1873, Hoffmann 1890, Gray 1884, Rydberg 1917) have disagreed as to the treatment of these genera, it was thought to be of interest to reevaluate their position.

Previous investigations were based largely on superficial morphological observations. In attempting to treat the problem in a more objective fashion, a more detailed cytological and morphological study has been attempted. This has been by no means exhaustive, but the new data offer, in the author's opinion, sufficient information to delimit these genera satisfactorily.

CONCEPT OF GENUS AND ITS RELATIVE VALUE

To give a definition of a genus is as hard a problem as to try to define a species and no attempt will be made to solve this problem here. Nevertheless, a few considerations might be pertinent to the problem under consideration. They also will illustrate the author's ideas about these matters and the underlying principles of this work.

A genus is formed by a group of species which share a series of common properties. It is also related to other genera by some common properties, so as to allow us to place them in a particular tribe, subfamily or family. There is no fixed set of rules that determines which characters will be of "generic" and which of "specific" value, but we may say that if the common properties a group of species share are greater than the properties this group shares with another set of species (viz. another genus), we usually place these two groups of species in different genera. On the other

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[1] Honorary travelling Fellow, University of California, and Botanist, Gray Herbarium, Harvard University. I am indebted to Dr. R. C. Rollins for suggestions and the reading of the manuscript.

hand if the species of the first group resemble those of the second group as much as each other, we usually place them in the same genus.

When the first case applies, that of a group of species resembling each other more than species of another group, we still might maintain them in the same genus, but in different subgenera or sections. This last procedure will be largely determined by the author's concept, and is therefore somewhat subjective. Also, it is likely to be influenced by the traditional usage in the family.

In the Compositae the tendency has been to erect many genera based on a few characters. The desirability of this could be disputed, but it has to a certain extent had a very practical basis. In a family as large and as homogeneous as this one, it is very hard to obtain a good understanding of large genera, e. g. *Senecio, Haplopappus, Baccharis, Solidago,* etc., while smaller groups (which are not necessarily always too small) can be better understood.

HISTORY OF THE GENERA UNDER STUDY

Xanthocephalum, with one species *X. centauroides,* was the first genus of this group to be described, in 1806, by Willdenow. The very brief description indicates only that the genus "belongs close to *Zoegea*"[2]

Lagasca (1816), in his original description of *Gutierrezia,* did not indicate its relationship to other genera. Nuttall (1818) indicated in his description of *Brachyris* (= *Gutierrezia*) the possesion of "vegetation almost similar to that of *Euthamia tenuifolia*". Both authors state that the involucre is formed by imbricated bracts, the heads are radiate, and the pappus paleaceous. However, all of these characters occur in several genera of Astereae, and therefore are not sufficient by themselves to define *Gutierrezia.*

The genus *Gymnosperma* was described by Lessing in 1819 based on *Selloa glutinosa* Spreng. Since *Selloa* H. B. K. a later name for another Mexican plant was conserved, *Selloa* Spreng. becomes a rejected name, and *Gymnosperma glutinosum* Less. is the correct name for the plant (Blake, 1930; Int. Rules Bot. Nom., Ap. III, Sect. X, 9168). Lessing states no relationships, other than the "undoubtedly asteraceous character" of the genus.

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[2] "Eine zur Syngenesia frustranea gehörige Gattung, die bei *Zoegea* stehen muss".

De Candolle (1836) defines *Brachyris* Nutt. (= *Gutierrezia*) according to its habitat, the number of ligulate and tubular flowers, the form of the inflorescence, and the pappus, which is formed by well developed paleae of moderate size. He placed it near *Gymnosperma* Less., which has a pappus of very minute teeth, and *Hemiachyris* D. C., a genus with one species in De Candolle's conception, *H. texana*, which differs from *Gutierrezia* in having a pappus of short paleae in the tubular flowers and none in the ligulate ones.

Nuttall (1841) elevated *Amphiachyris*, considered by De Candolle to be a section of *Gutierrezia* (*Brachyris*), to generic rank. The principal justification was given as the following constellation of characters: "the involucrum obovate and bracteolate, scales few and obtuse not herbaceous at the points", and the "pappus of the discal florets united at base, dividing into about six entire setae. Radial florets with a very minute crown of scarcely visible setae".

Torrey and Gray (1841) accepted Nuttall's treatment of *Amphiachyris* but reduced *Hemiachyris* D. C., to become a section of *Gutierrezia*, a step which has been accepted by all later workers. They placed *Gutierrezia* next to *Gymnosperma* and *Amphiachyris*, from which it differs by the pappus characters already cited, and next to *Brachychaeta*, which differs from the above mentioned genera by its setiform pappus.

Bentham and Hooker adopted a more conservative attitude in the Genera Plantarum (1873). They merged both *Hemiachyris* and *Amphiachyris*, as well as the quite distinct genus *Amphipappus*, which had been described by Torrey and Gray in 1845 from material collected by Fremont in California, with *Gutierrezia*. This complex was then placed near *Gymnosperma* and *Xanthocephalum*, which differ from *Gutierrezia* in lacking a paleaceous pappus. In addition, *Gymnosperma* differs by its possession of minute ligules instead of well developed ones as in the other genera, and *Xanthocephalum* by its broad involucre. Also, *Grindelia* is considered to be very close, differing mainly in the shape of the involucre and involucral bracts.

In the Synoptical Flora (1884), Gray adopted a point of view close to that which he had held in 1841, the main difference being the transfer of *Amphipappus fremontii* into

Amphiachyris. Hoffmann's treatment (1890) for Engler's Pflanzenfamilien is similar to that of Bentham and Hooker (1873).

Most authors of local or regional floras in the United States have followed Gray's views as expressed in his Synoptical Flora. Exceptions to this are Rydberg's Flora of the Rocky Mountains (1917), in which this author restores *Amphiachyris fremontii* to *Amphipappus* T. & G.; and Blake (1924) who accepted *Amphipappus fremontii* but considers *Amphiachyris dracunculoides* to belong to *Gutierrezia*.

Porter (1943) reviewed *Amphipappus* and effectively established its status as a separate genus.

A radically different point of view has recently been adopted by Shinners (1950), who merges *Gutierrezia*, *Gymnosperma*, *Amphiachyris* (including *Amphipappus*), and the heterochromous *Greenella* Gray, all under *Xanthocephalum*. For Shinners, "the quite variable features of pappus, size of heads, and number of rays" do not constitute differences sufficient to justify the maintainance of separate genera.

CYTOLOGICAL AND MORPHOLOGICAL OBSERVATIONS

CYTOLOGICAL STUDIES. An attempt has been made to determine the basic chromosome numbers of as many species as possible of all the genera under consideration, as well as those of other more or less related genera in Astereae-Solidaginae. Part of these data have been published elsewhere (Raven, Solbrig, Kyhos and Snow, 1960) and part are presented here.

Table 1 shows the chromosome numbers of species of *Gutierrezia*, *Amphipappus*, *Amphiachyris*, *Xanthocephalum* and *Gymnosperma*. Unfortunately, only one species of *Xanthocephalum* and none of *Greenella* could be counted. Each of these genera studied proved to have a different basic chromosome number: four in *Gutierrezia*, five in *Amphiachyris*, six in *Xanthocephalum*, seven in *Gymnosperma* and nine in *Amphipappus*. The chromosome number thus proved to be an absolute distinguishing character between the genera. It can also be seen how the chromosome number con-

TABLE 1. CHROMOSOME NUMBERS

Species	n	2n	No. of counts	Reference
Amphiachyris dracunculoides	5	10	2	Solbrig, 1959
Amphipappus fremontii	9	-	2	Raven, Solbrig, Kyhos and Snow, 1960
Gutierrezia texana	4	—	3	Solbrig, 1959
Gutierrezia glutinosa	4	—	2	Solbrig, 1959
Gutierrezia serotina	4	—	1	Solbrig, 1959
Gutierrezia sarothrae	4, 8	8	20	Solbrig, 1959
Gutierrezia microcephala	8, 16	—	6	Solbrig, 1959
Gutierrezia bracteata	8, 12	16, 24	10	Solbrig, 1959
Gutierrezia californica	12	—	1	Solbrig, 1959
Gymnosperma glutinosum	7	—	1	Solbrig, 1959
Xanthocephalum gymnospermoides	6	12	2	Solbrig, 1959

firms *Gutierrezia (Hemiachyris) texana* as a true *Gutierrezia.*

MORPHOLOGICAL STUDIES. — **Involucre.** The shape of the involucre can be used in delimiting the genera under consideration, but it is not sufficient by itself in certain cases.

Gutierrezia possesses a characteristic elongate-turbinate involucre which varies from slightly campanulate in *G. glutinosa* and broadly turbinate in *G. texana* to narrowly elongate-turbinate in *G. microcephala.* The involucres of *Amphipappus* and *Gymnosperma* do not differ essentially from that of *Gutierrezia.* In contrast with them, *Xanthocephalum, Amphiachyris*, and *Greenella* have broadly campanulate involucres. Of these last three genera, *Amphiachyris* has an involucre most similar to that of *Gutierrezia glutinosa* to the point that in some cases only close observation

permits their separation on this basis. The involucre of *Xanthocephalum*, on the other hand, is quite different and very similar to that of *Grindelia*, a genus similar to *Xanthocephalum* in habit and chromosome number. *Greenella* possesses an almost hemispherical involucre, which may be easily distinguished from that of all species of these genera with the exception of *Gutierrezia glutinosa* and *Amphiachyris dracunculoides*.

Involucral bracts. There is little variation in the involucral bracts, whether within or between genera. The bracts are herbaceous with a hyaline margin and a dark green tip. The involucral bracts of *Xanthocephalum* are a little darker in color than those of the other genera.

Pappus. The characters of the pappus, which were used by the very first botanists in the study of these genera, are very valuable, although not necessarily absolute, criteria for delimiting them.

In order to use the pappus characters successfully one must consider the pappus of both ligulate and tubular flowers and the variation present in different species.

In fig. 1 are depicted pappus scales and bristles characteristic of the different genera under consideration. *Gutierrezia* has the most distinctive and characteristic pappus of the group. Both ligulate and tubular flowers have a well developed pappus formed by lanceolate paleae, with a slightly fimbriate margin. The paleae of the ligulate flowers are usually slightly shorter; in *G. texana* they are absent or very reduced, a characteristic used by De Candolle in establishing the genus *Hemiachyris*. The paleae are about the same size as the achene except in *G. texana* and *G. glutinosa*, where they are shorter than the achene. In no case are they longer than the corolla (for a detailed analysis of the variation of this character in *Gutierrezia*, see Solbrig, 1959).

Amphipappus has numerous, linear, toothed, pappus-setae, which are slightly longer than the tubular corollas. They are sufficiently distinct to characterize the genus, as already noted by Asa Gray (1873). *Gymnosperma* and *Greenella* are similar in possessing a reduced crown of minute scales instead of a well developed pappus, in both ligulate and tubular corollas.

Xanthocephalum usually has only a low rim or crown in both ligulate and tubular corollas. It is not uncommon, however, to find in some or all of the tubular flowers of every species, one to three elongated, triangular-shaped, irregular awns.

Amphiachyris usually has no pappus at all in the ligulate flowers, or only a low, scaly ring. However, the tubular corollas, possess a pappus of few, ephemeral, dilated bristles

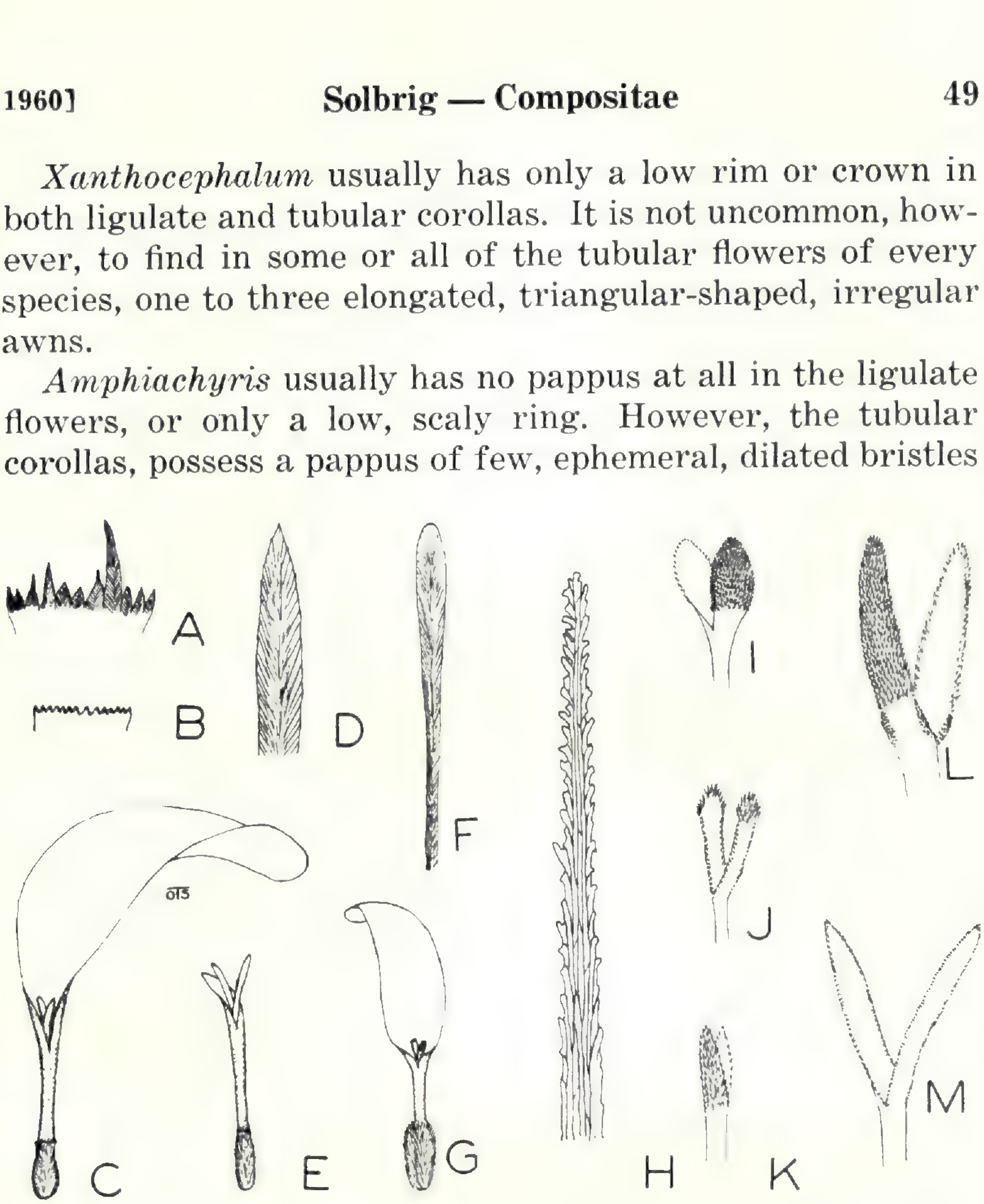

FIG. 1. *Xanthocephalum gymnospermoides: A.* Pappus × 5; *J.* Style of tubular flower × 16. *Xanthocephalum wrightii: C.* Ligulate flower × 2. *Gymnosperma glutinosum: B.* Pappus × 5; *E.* Ligulate flower × 2. *Gutierrezia sarothrae: D.* Pappus bristle × 5; *L.* Style tubular flower × 16. *Amphiachyris dracunculoides: F.* Pappus bristle × 5; *K.* Style tubular flower × 8. *Amphipappus fremontii: G.* Ligulate flower × 2; *H.* Pappus bristle × 5; *I.* Style tubular flower × 8; *M.* Style ligulate flower × 16.

which are fused at the base. There is some variation, with the bristles sometimes broad enough to resemble the characteristic paleae of *Gutierrezia*. This resemblance is nevertheless more apparent than real.

Corolla. The tubular corollas are essentially alike. The ligulate corollas manifest some significant differences in a few instances.

Gymnosperma has ray flowers with ligules which do not surpass the tubular corollas. In all the other genera the ray

corollas are bigger than the tubular ones. The ligules of *Xanthocephalum* are larger and more numerous than those of the other genera. *Greenella* is the only genus of the group with white ligules, all the other genera having yellow ones.

Anthers and pollen. The anthers are essentially alike in all the genera under consideration. Their shape is characteristically asteraceous, with a blunt base and a more or less triangular, rounded connective. The pollen is also very uniform in all the genera and is also of the characteristic type for the tribe.

Styles. The variation in styles is not very great from genus to genus; nevertheless, in certain cases the differences are significant enough to deserve attention, especially since classical synantherologists have attributed so much importance to characters of the styles in the delimitation of tribes and genera of Compositae (Bentham 1873).

The styles of the female ray flowers are different from those of the hermaphrodite tubular ones. We find in the ray flowers a style composed of two elongated branches, gradually attenuated toward the tip and with a border of papillae along both sides of the stigmatic branches. This situation holds true for all the genera considered here.

The branches of the style of the tubular flowers are shorter than those of the ligulate ones. In addition, instead of having the stigmatic papillae all around the border of the two stigmatic branches, they are confined to the lower quarter on both sides. Finally, both external sides of the stigmatic branches are covered with collecting hairs.

The collecting hairs may be well developed and pointed as in *Gutierrezia*, *Xanthocephalum*, *Greenella*, and *Amphiachyris*, or they may be slightly smaller and with rounded tips as in *Amphipappus* and *Gymnosperma*. These two genera also have elliptic rather than subulate style branches.

Stigmatic papillae are totally lacking in the tubular flowers of *Amphipappus fremontii* and *Gutierrezia microcephala*. In *Xanthocephalum gymnospermoides* the papillae extend beyond the middle of the stigmatic branches, while the collecting hairs are restricted to the upper part of the style (fig. 1). These variations have, nevertheless, only specific value.

TABLE 2. PRINCIPAL DIFFERENTIATING CHARACTERS

	GUTIERREZIA	AMPHIACHYRIS	XANTHOCEPHALUM	GYMNOSPERMA	AMPHIPAPPUS	GREENELLA
Basic chromosome no.	4	5	6	7	9	
Involucre	turbinate	campanulate	campanulate	turbinate	turbinate	campanulate
Pappus ligulate fl.	paleae	minute	minute	minute	minute	minute
Pappus tubular fl.	paleae	setae	minute and or squamellae	minute	setiform paleae	minute
Ligules	less than 15 medium-sized yellow	10 to 20 medium-sized yellow	more than 20 large yellow	less than 10 very short yellow	less than 10 medium-sized yellow	10 to 20 medium-sized white
Stigma branches	subulate	subulate	subulate	elliptic	elliptic	subulate
Collecting hairs	pointed	pointed	pointed	blunt	blunt	pointed
Habit	perennial or annual	annual	annual	perennial	perennial	perennial or annual
Blooming time	Fall	Fall	Fall	Fall	Spring	Fall

HABIT AND DISTRIBUTION

Amphipappus is the only spring-blooming genus of the group. It is a suffrutescent perennial shrub restricted to the regions of the Colorado River basin in southern Utah, Nevada and South-east California (Porter, 1943). The author's observations on one population near Shoshone, California, show that leaves and small branches die out entirely during the dry season. Unfortunately, this condition could not be confirmed for plants in the greenhouse, since they died shortly after blooming.

Xanthocephalum is a genus of annual, fall blooming plants, mostly from central Mexico (Matuda, 1958). Two species, *Xanthocephalum gymnospermoides* and *X. wrightii*, reach the mountains of southern Arizona and New Mexico, growing at elevations of 800 to 2,500 meters.

The number of species of *Greenella* is probably three. They are also mainly Mexican, growing on Cedros Island, Baja California, and in northern mainland Mexico and southern Arizona. They are perennial, fall-blooming plants, with the exception of the annual *G. arizonica*.

Gymnosperma glutinosum, the only member of the genus, ranges from northern Guatemala to Arizona, New Mexico and Texas. It is also perennial and fall-blooming.

Amphiachyris, as here delimited, has two species, *Amphiachyris dracunculoides* (DC.) Nutt., and *Amphiachyris amoenum* (Shinners) Solbrig[3]. Of these two annual, fall-bloomers, *A. dracunculoides* has apparently spread from its native habitat in Oklahoma and Texas throughout the dry parts of the Great Plains as far north as Kansas and Illinois and eastward into Kentucky and Louisiana. Nevertheless, it is considered to be a weed of only secondary importance. *Amphiachyris amoenum*, on the other hand is not common, being restricted to limestone soils of the Grand Prairie and eastern Edwards Plateau (Shinners, 1951).

Gutierrezia is the most widely distributed of this group of genera. It is found in western and central North America scattered in dry and rocky areas west of the central plains and reaching from Alberta and British Columbia in the north, to San Luis Potosi, Mexico, in the south. It is also

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[3] *Amphiachyris amoenum* (Shinners) comb. nov., based on *Xanthocephalum amoenum* Shinners Field and Lab. 19: 77, 1951.

found in South America, namely in south western Bolivia, northwestern Argentina and northern Chile. It prefers loose, sandy soils. The species are either globose perennial shrubs or stout annuals, these latter being restricted to northeastern Mexico, New Mexico, Texas and Oklahoma (Solbrig, 1959).

KEY TO THE GENERA

A. Ray corollas equaling or shorter than the tubular corollas ..... 1. GYMNOSPERMA.

AA. Ray corollas longer than tubular corollas.

B. Pappus of both ligulate and tubular flowers composed of several well developed paleae (lacking in the ray of *G. texana*) ..... 2. GUTIERREZIA.

BB. Pappus of both ligulate and tubular flowers composed of setae, or low toothed crown, or lacking.

C. Involucre turbinate, appressed; perennial spring-blooming shrubs ..... 3. AMPHIPAPPUS.

CC. Involucre campanulate; perennial or annual fall-blooming shrubs or herbs.

D. Perennial (Except *G. arizonica*); ligules white ..... 4. GREENELLA.

DD. Annuals; ligules yellow.

E. Rays more than 20; pappus of tubular flowers reduced to a crown of minute scales or with 2 or 3 squamellae ..... 5. XANTHOCEPHALUM.

EE. Rays less than 20; pappus of tubular flowers of few ephemeral setae fused at base ..... 6. AMPHIACHYRIS.

— GRAY HERBARIUM, HARVARD UNIVERSITY.

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SOME SISYMBRIUMS (CRUCIFERAE) NATIVE TO TEXAS AND NORTHEASTERN MEXICO

REED C. ROLLINS

The very close relationship of certain species of *Romanschulzia* to *Sisymbrium* has been recognized from the time of the founding of the former genus. In fact, it was established upon species then considered to belong to *Sisymbrium*. More recently (1956, 1957) I have been faced with the problem of species placement in the borderline area between the two genera. In general, *Romanschulzia* is characterized by having flowers with exserted, spreading stamens that are nearly equal in length, and by siliques borne on a definite gynophore. In several of the species, the calyx is calyptrate, being shed by the expanding anthers at anthesis. In addition, the cauline leaves are strongly auriculate and they are markedly differentiated from the basal leaves when present, which are petiolate. But some species of *Sisymbrium* have strongly auriculate cauline leaves and the basal leaves are more or less petiolate. So the line between these two genera, as with many other pairs or groups of genera in the *Cruciferae*, is a very tenuous one in certain boundary areas between them.

Several species of auriculate-leaved Sisymbriums of northeastern Mexico and extreme western Texas are of interest, not only because of their impingement on *Romanschulzia* but because only recently have we obtained sufficient material to provide an adequate basis for careful study. The problems posed by these materials range from nomenclatural ones to the accurate assessment and characterization of some little known or undescribed species. The first problem, touched on briefly by M. C. Johnston (1957), needs careful treatment because of the related species I wish to discuss and define.

Sisymbrium Vaseyi Watson in Robinson,
Syn. Fl. N. Am. **1**: 138. 1895.

In a curious treatment of this name, Payson (1922) listed it as a synonym of his newly proposed *Sisymbrium Watsonii*, at the same time attempting to produce a new *Sisymbrium*

Vaseyi based on *Thelypodium Vaseyi* Coulter. Such a transfer could not be legally made because of the preoccupation of the name in *Sisymbrium* by *S. Vaseyi* Watson. The result of Payson's action was that he proposed a new name for the wrong species. The name *Sisymbrium Vaseyi* Watson is legal in every respect, and the type, collected by G. R. Vasey in Las Vegas, New Mexico, in 1881, is in the Gray Herbarium. A second specimen, with the locality given as "mts. west of Las Vegas, N. Mex., *G. R. Vasey 41*, 1881" may possibly be part of the same collection, but this is not a certainty. This second collection, if it be that, is one of the two collections cited by Coulter (see below) when he described *Thelypodium Vaseyi*. Whether Watson's type was the same collection as that cited by Coulter is immaterial in the present problem because the two collections cited by Coulter, one by Vasey and the other by Nealley, belong to two different species. It is clear that Watson's intention was to describe a new species, for "n. sp." is written in his own hand after "Sisymbrium (?) Vaseyi" on the label of the holotype. The effect of Robinson's action in publishing Watson's name, *Sisymbrium Vaseyi*, was to restrict the application of the name *Thelypodium Vaseyi* Coulter to the species represented by the Nealley specimen, which became the type, since Coulter had not himself chosen a type for the name. Robinson, as author of the treatise on *Sisymbrium* in the Synoptical Flora, was the one who supplied notes and a description for Watson's name and there was no confusion in his treatment whatever.

Sisymbrium Vaseyi Watson is so far known only from New Mexico. I think Johnston's (l. c.) statement that it is Mexican must have been a slip. The species associated with the name *Thelypodium Vaseyi* has been known from extreme southwestern Texas and now has turned up in Tamaulipas, Mexico. It must now be known by the following name:

Sisymbrium Shinnersii M. C. Johnston,
Southwestern Nat. **2**: 129. 1957.

Based on *Thelypodium Vaseyi* Coulter, Contrib. U. S. Nat. Herb. **1**: 30. 1890; not *Sisymbrium Vaseyi* Watson.

Coulter cited two collections following the description of

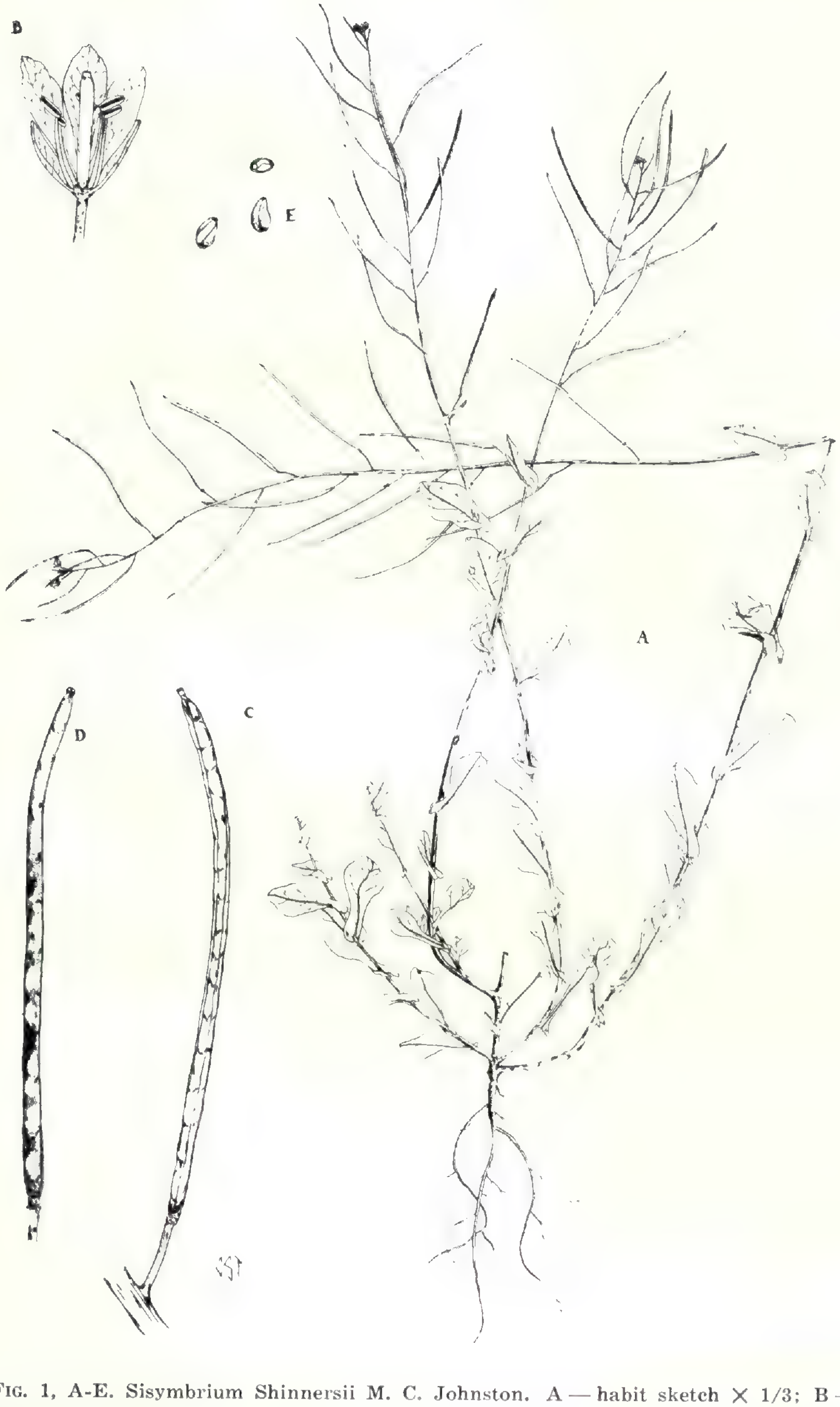

FIG. 1, A-E. Sisymbrium Shinnersii M. C. Johnston. A — habit sketch × 1/3; B — flower with stamen and petal removed × 3; C — silique and pedicel × 1; D — replum showing funiculi × 1; E — seeds, surface and sectional views, × 3. Drawings by C. S. Tsao.

T. Vaseyi: "near Rio Grande City, Texas (Nealley); also collected in 1881 by G. R. Vasey (No. 29) in the mountains west of Las Vegas, New Mexico, in immature condition." Coulter further states, "Vasey's plants were too young to be characterized, although Mr. Watson, to whom the specimens were submitted, considered them as probably representing a new species. Mr. Nealley's specimens supply nearly mature pods, which may become longer than noted in the description." When this evidence is added to the fact that Coulter's paper is entitled, "Upon a collection of plants made by Mr. G. C. Nealley, in the region of the Rio Grande, in Texas, from Brazos Santiago to El Paso County", it is clear that the type of *Thelypodium Vaseyi* is, and ought to be, the Nealley specimen.

Johnston's short note proposing the new name *Sisymbrium Shinnersii* gave one new citation, that of *Runyon 3788*, in addition to those of Payson (l. c.). We now have the following recent collections to report that amplify and extend considerably the previously known range of this species. TEXAS: Cameron County, 6 miles northeast of Olmito, April 20, 1959, *Rollins and Correll 5953* (GH, LL); 3 miles northwest of Russelltown, near San Benito, April 20, 1959, *Rollins and Correll 5954* (GH, LL); Arroyo Colorado, just south of Harlingen, April 21, 1959, *Rollins and Correll 5956* (GH, LL); Barreda Tract, Barreda, April 11, 1941, *Runyon 2521* (GH). MEXICO: Tamaulipas, region of Rancho Las Yucas, ca. 40 km. nnw. of Aldama, Municipio de Aldama, July 25, 1957, *R. L. Dressler 2014* (GH); same locality, October 16, 1957, *R. L. Dressler 2427* (GH). *S. Shinnersii* is illustrated in fig. 1.

Sisymbrium arcuatum Rollins, sp. nov.

Annual; stem single from base, erect, weak, usually branched at each node, occasionally simple, glabrous, 5-10 dm. high; leaves all sessile and auriculate, entire, lower nearly pandurate, gradually becoming ovate to broadly oblong upward, glaucous beneath, greenish above, 2-8 cm. long, 1-4 cm. wide; inflorescences terminating each branch lax and much elongated; sepals purplish, glabrous, narrowly oblong, nonsaccate, 3-4 mm. long, ca. 1 mm. wide; petals white, spatulate with a slender claw, 5-6 mm. long, ca. 2 mm. wide; filaments not swollen at base, 3-4 mm. long; filaments of single stamens not appreciably shorter than those of paired stamens; anthers purplish, ca. 2 mm. long; siliques terete, slender, sessile, widely spreading, becoming somewhat pendulous, slightly arched downward to nearly straight, 1-3-

nerved, 8-10 cm. long, about 1 mm. in diameter; styles 1-1.5 mm. long; stigmas unexpanded; pedicels spreading to slightly recurved, 8-11 mm. long, slightly expanded at summit; seeds immature, wingless, oblong.

Herba annua; caulibus erectis vel cernuis ramosis glabris 5-10 dm. altis; foliis sessilibus amplexicaulibus auriculatis integris glabris 2-8 cm. longis, 1-4 cm. latis, inferne panduratis vel ovatis, superne ovatis vel late oblongis; sepalis purpureis nonsaccatis anguste oblongis 3-4 mm. longis; petalis albis spathulatis 5-6 mm. longis; pedicellis fructiferis patentibus tenuibus glabris 8-11 mm. longis; siliquis sessilibus anguste linearibus teretibus patentibus vel late pendulis plus minusve arcuatis 8-10 cm. longis, ca. 1 mm. in diametro; stylis 1-1.5 mm. longis; seminibus immaturis oblongis immarginatis.

Type in the Gray Herbarium collected on a slope in open pinyon forest, 1-2 miles southwest of Pablillo, Nuevo León, Mexico, July 21, 1958, *D. S. Correll and I. M. Johnston 19941*. Isotype in the Lundell Herbarium, Texas Research Foundation.

Sisymbrium arcuatum is nearest related to *S. Shinnersii*. From the latter, it differs in having much longer, arcuate and widely spreading more or less pendulous siliques and somewhat pandurate lower leaves. In *S. Shinnersii*, the siliques are divaricately ascending, straight and with a maximum length of about 6 cm. instead of 10 cm. as in *S. arcuatum*. In the latter species, the pedicels are widely spreading and somewhat arched downward, whereas in *S. Shinnersii*, the pedicels are rigidly divaricate, straight and always ascending. Both species have very slender siliques.

Sisymbrium Purpusii (Brandegee) O. E. Schulz, Pflanzenr. 86, (IV, 105) 58. 1924.

Based on *Thelypodium Purpusii* Brandegee, Zoe 5: 232. 1906.

Annual; stems single from the base, erect, branched at nearly every node; glabrous, leafy, 3-7 dm. high; branches ascending, dense; lower leaves sinuate-dentate to somewhat lobed, thin, glabrous, with a broad and conspicuous central vein, petiolate, oblanceolate, obtuse, 6-15 cm. long, 1-3 cm. wide, petiole winged; cauline leaves becoming sessile and auriculate, sparsely dentate to entire, middle and upper leaves lanceolate and amplexicaule; sepals greenish, oblong, scarious-margined, nonsaccate, glabrous, 3-3.5 mm. long, ca. 1 mm. wide; petals spatulate, with a slender claw, white, 4-5 mm. long, ca. 1.5 mm. wide; filaments of single stamens markedly shorter than those of the paired stamens, filaments of paired stamens 3-4 mm. long; anthers oval, less than 1 mm. long; pedicels slender, divaricately ascending to nearly erect, straight, glabrous, 1-1.5 cm. long; immature siliques narrowly linear, terete, straight, ascending, 4-7 cm. long, ca. 1 mm. in diameter; styles ca. 1 mm. long.

The above amplified description of *S. Purpusii* takes new-

ly found Texas specimens into account. This Texas material is the first from the United States and the only specimens I have seen other than the two Purpus collections cited by Brandegee at the time the species was proposed. Dr. M. C. Johnston informs me that the place of collection, as indicated below, is relatively inaccessible. The following numbers are in the Gray Herbarium: *M. C. Johnston and B. H. Warnock 3734, 3735 and 3736*, all collected at an altitude of 3,300 ft. in different habitats on the McCormick Ranch, small lateral canyon southwest of Old Smith Ranch, near Fresno Canyon, Presidio County, Texas, March 1, 1959.

Sisymbrium Purpusii is in the general alliance of *S. Shinnersii* and *S. arcuatum* but the species is not closely related to either of them. In particular, the leaves are of a different shape and texture. The plants of *S. Purpusii* tend to be leafy and the branching is often rather virgate with the branches markedly ascending. The considerably elongated lower leaves are petioled and sinuate to somewhat lobed in contrast to the sessile and auriculate comparable lower leaves of both *S. Shinnersii and S. arcuatum*. In none of these species is there a strictly basal rosette. The nearest approach to this is in *S. Purpusii* in particular plants that grow slowly at first, producing short internodes between the leaves. But in such instances the leaves are merely crowded and the leaf arrangement is not a rosette in the usual sense.

The anthers of *S. Purpusii* are oval and less than half as long as those of either *S. arcuatum* or *S. Shinnersii* where the anthers are oblong in shape. The nearest relative of *S. Purpusii* is *S. Kearneyi*, a species at present known only from the Grand Canyon of Arizona. — GRAY HERBARIUM OF HARVARD UNIVERSITY.

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Volume 62, No. 733, including pages 1-30, was issued January 22, 1960.

GRAY HERBARIUM LIBRARY APR 8 1960

RHODORA

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

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Vol. 62 March, 1960 No. 735

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

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Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

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REVISION OF HETEROTHECA, SECTION HETEROTHECA (COMPOSITAE)[1]

BURDETTE L. WAGENKNECHT

Heterotheca until recently has been considered to be a small genus of the tribe Astereae and has not been treated systematically since De Candolle's revision for the Prodromus (1836). Shinners (1951) merged *Chrysopsis* with *Heterotheca*, resulting in a considerably enlarged genus. Acceptance of this merger requires that the species constituting *Heterotheca sensu stricto* should be placed in *Heterotheca*, section *Heterotheca*, and the remaining species arranged in various sections similar to those in which they had been previously placed in *Chrysopsis*.

Heterotheca section *Heterotheca* is native to continental North America and is an occupant of sandy or disturbed habitats. It ranges from Long Island south to Georgia and Florida on the coastal plain, west to California and from Illinois southwest to the state of Oaxaca, Mexico. It has been introduced in Brazil and Hawaii and one species is rarely cultivated in Europe.

The present treatment is based upon the examination of

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[1]Part of a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the University of Kansas. I should like to take this opportunity to express my appreciation to Prof. R. L. McGregor for his advice and assistance while directing this study. The critical examination of the manuscript by Dr. L. H. Shinners of Southern Methodist University has been helpful. A grant from the Society of the Sigma Xi made possible much of the field work undertaken in connection with this study.

more than 1500 specimens from fifteen[2] herbaria, and a study of three species and their varieties in the field. Only a limited number of representative specimens are cited for most of the taxa involved. A complete list of all specimens examined in this study may be found in the original thesis at the Library of the University of Kansas.

Generic Relationships

The first species of *Heterotheca* was described as a species of *Inula*. *Heterotheca* can be separated from *Inula* and the tribe Inuleae by the flattened and smooth style-branches, extended into lanceolate hairy appendages and by the obtuse and barely notched anther bases. Bentham and Hooker (1876) placed the genus *Heterotheca* in the tribe Astereae. The most closely related genus is *Chrysopsis*, which shows great similarity in its morphology and its preference for sandy habitats. *Heterotheca* as a genus is of a more weedy nature. These two genera are usually maintained as separate entities because of the absence of a pappus from the ray achenes in *Heterotheca* and the presence of a well-developed double pappus on the ray achenes in *Chrysopsis*.

At least two authors have felt that the two genera should not be separated. Baillon (1886) not only merged *Chrysopsis* and *Heterotheca* with *Hysterionica* but also included *Grindelia*, *Pentachaeta*, *Aphantochaeta*, *Bradburia*, *Haplopappus*, *Xanthisma*, *Chrysothamnus* and *Lessingia* under the same genus. The above listed genera were to be considered as sections of *Hysterionica*. No transfers of species were made. The elongated lanceolate stylar appendage can be used to separate *Heterotheca* and *Chrysopsis* from *Hysterionica*, which has a short deltoid stylar appendage.

Shinners (1951) questioned only the segregation of *Heterotheca* and *Chrysopsis* and pointed out that it seemed unreasonable to preserve all the diverse sections of *Chrysopsis* within the same genus and to exclude *Heterotheca*,

[2]The abbreviations employed in referring to these herbaria are those of Lanjouw and Stafleu (1952) and are as follows: CU, Cornell University; F, Chicago Natural History Museum; GH, Gray Herbarium; KANU, University of Kansas; MEXU, Universidad Nacional de Mexico; MO, Missouri Botanical Garden; NEB, University of Nebraska; NY, New York Botanical Garden; OKLA, Oklahoma State University; P, Museum National d'Histoire Naturelle; PH, Academy of Natural Sciences of Philadelphia; SMU Southern Methodist University; TEX, University of Texas; UC, University of California; and US, United States National Herbarium.

which resembles closely certain sections of *Chrysopsis*. In particular he thought it inconsistent to segregate *Heterotheca* based on the absence of the pappus from the ray achenes and to maintain the section *Ammodia*, as a part of *Chrysopsis*, even though the entire ray cycle of the head was missing.

One line of investigation which offered the best interpretation of this situation was a study of the pappus characters of all specimens studied. In all manuals treating the genus, there are references to the presence of at least a rudimentary pappus on the ray achenes. De Candolle considered *Heterotheca chrysopsidis* to be sectionally distinct from the remainder of the genus because of the presence of a pappus on the ray achenes. His use of the epithet *chrysopsidis* is a reflection on his observation of an intermediate character between *Heterotheca* and *Chrysopsis*. Examination of the isotypes of this species reveals that the pappus characters indicated by De Candolle were not consistent in all specimens within the type collection.

Studies of all collections throughout the genus revealed that approximately three per cent of the specimens examined bore a rudimentary pappus. One specimen, *F. B. Jones 430*, from San Patricio Co., Texas (OKLA), is of great interest. The ray achenes produced by this plant bear a double pappus indistinguishable from that of the disk achenes. In addition to the presence of a pappus, the ray achenes further resemble the disk achenes in that they are densely sericeus. Another specimen (SMU), bearing an identical label and of identical appearance, has glabrous, epappose ray achenes. Any attempt to identify these two plants with current keys other than those of Shinners (1958) would result in the placing of these two specimens in different genera. The discovery of such wide variability of the pappus within *Heterotheca*, including that characteristic of *Chrysopsis*, leads me to support Shinners' conclusion that the two genera should be merged.

One other genus shows some relationship with the group studied. *Croptilon (Isopappus;* often included in *Haplopappus)* can be distinguished from *Heterotheca* by the single pappus found on the disk achenes. Those specimens of *Heterotheca grandiflora* in which disk achenes lack an outer

pappus show a trend in this direction. However, the merging of *Croptilon* with *Heterotheca* could not be recommended without a great deal of further study.

Chromosome numbers have not provided any evidence for or against the merger of these genera. Darlington's lists (1956) show n=9 to be the most common number in the tribe Astereae. This was the number found in *Heterotheca grandiflora* by Heiser (1948). Dr. R. C. Jackson, Department of Botany, University of Kansas, and I found n=9 in *H. latifolia* var *macgregoris*. (Voucher specimen *Wagenknecht 4640*, 1 mi. s. Coldwater, Comanche Co., Kansas, on file at the Herbarium of the University of Kansas (KANU)). Dr. B. L. Turner, University of Texas, informs me in private correspondence that he has unpublished counts n=9 in *Chrysopis graminifolia* and *Heterotheca inuloides*. Dr. R. C. Jackson (1959) has a count of n=18 in *Chrysopsis foliosa* Nutt. Dr. Turner (1959) has reported n=5 in *Chrysopsis pilosa* and more recently, he sent me a manuscript by Mr. M. O. Cherry, Biology Department, Pasadena High School, Pasadena, Texas, correcting this latter number to n=4.

Taxonomic Treatment

Heterotheca Cassini, Bull. Soc. Philom. 137. 1817

Calycium Ell., Sketch **2**: 338. 1824.

Diplocoma D. Don in Sweet, Brit. Fl. Gard. **3**: 246. 1828.

Stelmanis Raf., Fl. Tellur. **2**: 47. 1836.

Heterotheca section *Chaetactis* DC., Prod. **5**: 317. 1836.

Heterotheca section *Gymnactis* DC., Prod. **5**: 317. 1836.

Hysterionica section *Heterotheca* Baillon, Histoire des Plantes **8**: 155. 1886.

Annual, biennial, or perennial, simple, or branched aromatic herbs. Stem strict, ascending, or decumbent, striate, pilose, sericeous, scabrous or glandular-hairy. Leaves alternate, simple, entire, dentate to serrate, ovate to lanceolate, to elliptical, scabrous to hirsute above, scabrous to pilose below. Basal and lower cauline leaves petiolate, the petioles often with auriculate-clasping bases; upper cauline leaves sessile. Inflorescence paniculate to corymbose, the heads on short lateral branches, smaller than those terminating main branches. Heads hemispheric to broadly campanulate, the phyllaries in 4-6 series, glabrous, glandular-hairy, scabrous or sericeous, the inner series with scarious edges, the tips pilose. Ray flowers numerous, pistillate, often abortive, spreading, characteristically rolling into a tight coil when dried, narrowly ligulate, or linear, each terminated by three teeth, tubular at the base,

the tube pubescent, producing a slender glabrous style, and a narrow, glabrous, bifid stigma, the achene trigonous, glabrous to slightly sericeous, the pappus absent or present as a toothed crown or as a few caducous bristles. Disk flowers numerous, perfect, tubular, slender at the base and widening upwards, five-toothed, five-nerved, the nerves alternate with the ovate-lanceolate, acute, spreading teeth. Stamens five, naked at the base with deltoid appendages at the apex, exserted from corolla at anthesis. Style glabrous, bifid, short, villous at the acute apex. Achene compressed, hispid to sericeous, crowned with a radiately spreading double pappus, the inner series of long, brown, slender, barbellate hairs, the outer series of short, flat, chaff-like appendages or of short, barbellate hairs, white or of the same color as the inner series. Receptacle flat, alveolate, the partitions between the achenes scarious, the points very unequal.

Native to the United States and Mexico, introduced in Hawaii and Brazil. TYPE SPECIES: *Heterotheca subaxillaris* (Lam.) Britton & Rusby.

In 1824, Elliott proposed a provisional genus *Calycium*, depending upon whether *Inula scabra Pursh* should be considered sufficiently distinct to warrant generic segregation. However, no transfer of the specific epithet was made.

KEY TO SPECIES AND VARITIES

1. Habit strict, — 1-2.5 m. tall (spring form 10-30 cm. tall); stem 0.9-1.7 cm. in diameter; cauline leaves petiolate below, sessile above, coarsely serrate to entire; inflorescence of short, paniculate axillary branches; peduncles and phyllaries densely capitate-glandular. ..... *H. grandiflora.*
1. Habit erect to procumbent, if strict; inflorescence corymbose; stems less than 0.9 cm. in diameter, or if larger, with cordate, clasping, cauline leaves; peduncles and phyllaries not densely capitate-glandular.
2. Habit erect or of several strict stems from a central caudex; lateral branches not well developed; inflorescence corymbose; leaves lanceolate; peduncles elongate and devoid of leaves.
3. Perennial, several strict stems arising from a central caudex; heads 1.5-3.0 cm. in diameter, broadly campanulate.
4. Stem and leaves densely pilose to villous; phyllaries densely villous with large jointed hairs. .... *H. inuloides* var. *inuloides.*
4. Stem and leaves pilose; phyllaries with sparse, slender hairs. ..... *H. inuloides* var. *rosei.*
3. Annual, heads 0.5-1.2 cm. in diameter, narrowly campanulate. ..... *H. leptoglossa.*
2. Habit erect to decumbent, the lateral branches well developed; leaves ovate, elliptical to lanceolate; inflorescence paniculate to paniculate-corymbose; peduncles remotely to densely foliar.
5. Perennial from well-developed woody caudex; blades of basal and cauline leaves ovate to elliptical, serrate to rarely entire, petiolate, the petioles of basal leaves up to 4 cm. in length; pappus a deep reddish-brown. ..... *H. chrysopsidis.*

5. Annual or weakly perennial, the caudex not developed; leaves elliptical or lanceolate, serrate to entire, the petioles of basal leaves less than 3 cm. long; pappus tan to white.
6. Habit erect to decumbent, up to 1 m. tall, the stem scabrous; lower leaf surface scabrous; phyllaries with well-defined tuft of short thick hairs on outer surface.
7. Habit erect; basal leaves serrate, the lateral veins readily discernible. ..... *H. subaxillaris* var. *subaxillaris.*
7. Habit procumbent; basal leaves entire or remotely serrate, the veins obscure. ..... *H. subaxillaris* var. *procumbens.*
6. Habit erect, up to 2 m. in height; stem and lower leaf surfaces velutinous or pilose, the upper leaf surface scabrous to pilose; phyllaries sericeous and sparsely glandular.
8. Stem up to 1.2 cm. in diameter, the lateral branches coarse; leaves cordate-clasping, sparsely pilose above; phyllaries densely glandular and pilose. ..... *H. psammophila.*
8. Stem 4-9 mm. in diameter, the lateral branches slender, or if coarse, leaves long-pilose; phyllaries not densely glandular.
9. Leaves scabrous above; heads less than 0.9 cm. in width. ..... *H. latifolia* var. *latifolia.*
9. Leaves pilose or velutinous above; heads more than 0.9 cm. wide.
10. Lateral branches slender; leaves oblong-lanceolate, the veins not prominently raised.
..... *H. latifolia* var. *macgregoris.*
10. Lateral branches coarse; leaves elliptical to lanceolate, the veins prominently raised.
..... *H. latifolia* var. *arkansana.*

1. **H. grandiflora** Nutt., Trans. Am. Philos. Soc. Ser. 2, **7**: 315. 1841
Diplopappus scaber (Pursh) Hook., Fl. Bor. Am. **2**: 22. 1834. Not *Heterotheca scabra* (Nutt.) DC.; *Inula scabra* Nutt.; *Inula scabra* Pursh. *Heterotheca floribunda* Bentham in Hinds, Bot. Sulph. 24. 1844.

Annual or biennial, somewhat rosulate, aromatic herbs, 0.5-2.5 m. (spring form 10-30 cm.) tall, unbranched below or with serotinous, assurgent basal branches. Stem striate, coarse, up to 1.7 cm. in diameter at the base, glandular-hairy above, progressively more densely hirsute below with spreading hairs up to 6 mm. long. Leaves ovate to elliptical or oblong, serrate to entire, 5-8 cm. long, 2-3 cm. wide, pilose on both surfaces. Lower cauline leaves petiolate, the petioles 3-7 cm. long, expanded into auriculate-clasping bases. Cauline leaves progressively smaller upwards, 2-4 cm. long, 0.5-1.5 cm. wide, sessile, coarsely serrate, oblong-lanceolate. Inflorescence paniculate-axillary, the involucres at the tips of the terminal branches 9-14 mm. wide, 6-9 mm. high, those of the short lateral branches 9-14 mm. wide, 6-9 mm. high, the heads campanulate to hemispherical. Phyllaries in 4-6 series, the outer series 3-5 mm. long, the inner series 6-9 mm. long, densely

capitate-glandular on the outer surface, the margins scarious, the apex villous. Ray flowers 25-40, the corolla-tube 4-7 mm. long, the ligule 5-8 mm. long; disk flowers 30-75, the tube 4-6 mm. long. Ray achenes 2-5 mm. long, epappose, trigonous, glabrous or slightly sericeous on the angles. Disk achenes 4-6 mm. long, obovate, compressed, sericious. Pappus of two series, the inner series of numerous barbellate bristles, 6-9 mm. long, reddish brown to white, the outer series squamellate setaceous or of short barbellate bristles 0.4-0.7 mm. long, or absent. Receptacle flat, white, alveolate, the partitions irregularly terminated by unequal chartaceous teeth.

TIME OF FLOWERING: April to December.

TYPE AND TYPE LOCALITY: "Rocks, circa Santa Barbara." Nuttall. not seen.

DISTRIBUTION AND HABITATS: native in eastern Arizona, California, Sonora and Baja California, Mexico and introduced in Hawaii. Sandy or disturbed soils at altitudes from sea level to 2,000 feet.

The first reference to this species is that of Hooker (1834). He erroneously considered it to be *Inula scabra* Pursh and in his treatment of the species transferred it to the genus *Diplopappus* as *D. scaber*. The description of Pursh cites *Inula subaxillaris* Lam. as a synonym and is therefore illegitimate under Article 60 of the Rules of Nomenclature. Hooker's transfer of this illegitimate epithet is also illegitimate.

Heterotheca floribunda Bentham was collected in the vicinity of San Pedro and of San Quentin, California, areas in which *H. grandiflora* was at the time the sole representative of this genus. Bentham's description matches Nuttall's earlier description in all essential points and is here, as in most previous works covering this species, considered to be a synonym of *H. grandiflora* Nutt.

The weedy nature of the species is shown by the appearance on a great many labels of habitats described as disturbed ground, fields, lots and roadsides. The creation of these habitats through urbanization and agricultural practices has increased its range. An indication that it is extending the northern boundaries of its range can be shown by a study of the dates of earliest collections in various California counties. In general, the first collections in counties south of San Francisco bear dates at least twenty-five years earlier than those of counties north of San Francisco.

Degener (1934) states that this species was introduced into the Hawaiian Islands before 1920. St. John and Hosaka

(1932) reported *Heterotheca grandiflora* as a noxious weed of the pineapple fields of Hawaii.

Representative specimens. **Arizona:** Santa Rita Forest Reserve, *Griffiths 5977* (US). **California:** Alameda Co.: *Rose 49180* (NY). Butte Co.: 1 mi. above Pentz, *Heller 15840* (UC). Contra Costa Co.: Antioch, *E. Crum 1731* (UC). Fresno Co.: *Brandegee, July 20, 1905* (US). Los Angeles Co.: bank of Arroyo Seco, *Grinnell 377* (F); Catalina Island, *Nuttall 864* (F). Monterey Co.: 1 mi. northeast of Elkhorn, *Axelrod 616* (UC). Orange Co.: *Mason 2901* (UC). Placer Co.: Wheatland, *Heller 13833* (F, US). Riverside Co.: Riverside, *Barrus 22* (CU). San Benito Co.: *Balls 15890* (OKLA). San Bernardino Co.: San Bernardino Valley, *S. & W. Parrish 177* (F, GH, NY, P, PH, UC, US). San Mateo Co.: *Rose 34478* (OKLA). Santa Barbara Co.: near type area, Santa Barbara, *Eastwood 127* (F, GH, NY, UC, US). Santa Clara Co.: San Jose, *Davy 243* (UC). Santa Cruz Co.: 5 mi. S. Santa Cruz, *Wiegand 2416* (CU). Sonoma Co.: Northwood, *Hoffman* (UC). Stanislaus Co.: Oakdale, *Crum 1552* (UC). Tuolumne Co.: 1 mi. W. Confidence, *Belshaw 191* (UC). MEXICO: **Baja California:** 27 mi. N. Ensenada, *Wiggins and Gillespie 3969* (F, GH, MEXU, MO, NY, US). **Sonora:** *Fr. Thomas* (P).

2. **H. inuloides** Cass., Dict. Sci. Nat. **51**: 460. 1827

Annual, biennial, or short lived perennial aromatic herbs, 50-150 cm. tall, unbranched below (second year's growth of several basal, assurgent branches arising from a central caudex), the stem striate, coarse, villous, green or various shades of purple. Leaves ovate to lanceolate, entire to serrate, 3-7 cm. long, 1-3 cm. wide, pilose on upper and lower surfaces. Lower cauline leaves petiolate, the petioles 2-8 cm. long, often with auriculate-clasping bases. Cauline leaves becoming progressively smaller above, 2-5 cm. long, 0.3-2 cm. wide, sessile, entire, lanceolate. Inflorescence corymbose. Involucres 1.5-3.0 cm. wide, 1.0-1.8 cm. high, hemispheric to broadly campanulate. Phyllaries in 4-6 series, the outer 2-4 mm. long, the inner 7-14 mm. long, densely villous to pilose on outer surface, the hairs prominently multicellular to unicellular, the tips purple, pilose, edges scarious. Ray flowers 25-40, the corolla tube 4-7 mm. long, the ligule 8-15 mm. long; disk flowers 40-60, the corolla tube 4-7 mm. long. Ray achenes 2-4 mm. long, trigonous, glabrous or with a few sericeous hairs. Disk achenes 2.5-5 mm. long, compressed, obovate, densely sericeous. Inner pappus of numerous barbellate bristles 4-9 mm. long, the outer squamellate-setaceous, or of short barbellate bristles 0.3-0.6 mm. long. Receptacle flat, white, alveolate, the partitions irregularly terminated by unequal chartaceous or occasionally fleshy points.

2a. **H. inuloides** var. **inuloides**

Diplocoma villosa D. Don, in Sweet, Brit. Fl. Gard. **3**:246. 1828.

Doronicum mexicanum Cerv., in Link & Otto, Icones Pl. Rar. 43. 1828.

Leaves and stems densely pilose, the phyllaries densely villous with long jointed hairs.

TIME OF FLOWERING: April to December.

TYPE AND TYPE LOCALITY: Desfontaines, reported to be in the Herbarium Universitatis Florentinae, Florence, Italy. Cultivated in The Garden of the King. Grown from seeds thought to have come from DeCandolle, who thought they were of Mexican origin. Not seen.

DISTRIBUTION AND HABITATS: San Luis Potosi to southern Oaxaca, and from Orizaba to the western border of the state of Mexico. Sandy or sandy clay soils, open pine forests, fields, and roadsides, at altitudes of 4,000 to 10,000 feet.

Although Cassini (1827) was not sure of the country of origin or the manner in which the plant arrived at the Jardin du Roi, the description is quite precise. His description of the involucre and foliage permits no doubt that his plants belong to the variety *inuloides*.

Diplocoma villosa Don and *Doronicum mexicanum* Cerv. are not only well described but are also illustrated in detail. A comparison of these descriptions and illustrations with Cassini's description and with specimens of *Heterotheca inuloides* leaves no doubt that these are the same species.

This species has been used by the natives of central Mexico as a medicinal herb. The leaves and involucres are dried, packaged and sold in small shops under the common name "Arnica." The medicinal properties attributed to concoctions from this plant are similar to those attributed to the European Arnica and probably account for the common name. The illustration in Ramirez' (1898) account of the medicinal properties of the species appears to be of this variety, although there is no reason to expect that the following variety is not used for the same purpose.

Representative specimens. MEXICO: **Federal District:** Ajusco, *Lyonnet 434* (GH, NY). Rio Frio, *Wagenknecht 2783* (KANU); Temascaltepec, *Hinton 847* (NY, SMU, US). **Hidalgo:** Valley of Tula, *Pringle* (PH, UC, US). **Morelos:** Cuernavaca, *Kenoyer A 151* (F, GH). **Oaxaca:** Vincente Guerro, *Wagenknecht 2795* (KANU); Monte Alban, *Kenoyer 1524* (GH). **Puebla:** Esperanza, *Pittier 401* (US); Teziutlan, *Wagenknecht 2825* (KANU). **San Luis Potosi:** San Luis Potosi, *Parry & Palmer 372* (GH, NY, US). **Vera Cruz:** Orizaba, *Seaton 164* (F, GH, NY, MO, US).

2b. **H. inuloides** var. **rosei** var. nov.

A varietate *inuloides* differt caule et foliis plus minusve pilosis, foliis ciliatis, phyllariis villosis.

Leaves and stem sparsely pilose, leaf margins ciliate, phyllaries sparingly villous.

The varietal epithet honors J. N. Rose whose comments on variation in this species led to the discovery of this variety.

TIME OF FLOWERING: April to December.

TYPE: *B. L. Wagenknecht 2846*, sandy soil along roadsides, 30 miles east of Guadalajara, Jalisco, Mexico. July 25, 1956. (KANU).

DISTRIBUTION AND HABITATS: States of Aguascalientes, Colima, Jalisco, Michoacán, Nayarit, and Zacatecas. Sandy soil along roadsides, in fields and open pine forests at altitudes of 3,000 to 5,000 feet.

This entity has been the source of some previous discussion. Gray (1887) examined *Palmer 268* from Guadalajara, Jalisco, and referred it to *Heterotheca leptoglossa* DC., regarding it as only a form of *H. lamarckii* Cass. [H. subaxillaris]. J. N. Rose (1894) examined the same specimen, noted the larger heads and more numerous rays, and placed it in *H. inuloides* Cass. as a form. My examination of this specimen has led me to agree more closely with Rose. The variation described above includes this specimen and is geographically distributed in a manner to warrant its treatment as a variety.

Representative specimens. MEXICO: **Aguascalientes:** Aguascalientes, *Hartweg 109* (NY). **Colima:** Tonila, *Jones 268* (US). **Jalisco:** Guadalajara, *Runyon 1352* (US), *Palmer 268* (US), Mazamitla, *McVaugh 13078* (SMU), 3 mi. S. Mazamitla, *Wagenknecht 2842* (KANU). **Michoacán:** Hidalgo, *Hitchcock and Stanford 7186* (NY, UC, US), Tancitaro, *Hinton 15477* (GH, PH). **Nayarit:** Tepic, *Palmer 2020* (US). **Zacatecas:** Suchil, *Gentry 8557* (GH, UC).

3. **H. leptoglossa** DC., Prod. 5: 317. 1836

Annual aromatic herbs, 0.5-1 m. tall. Stems strict, striate, hispid to pilose, the hairs up to 2.5 mm. long. Leaves lanceolate to linear-lanceolate, entire to dentate to serrate, 1.5-8 cm. long, 0.2-3 cm. wide, pilose on upper and lower surfaces. Cauline leaves progressively smaller upwards, 1-5 cm. long, 0.3-2 cm. wide, becoming sessile, entire. Lower cauline leaves serrate, petiolate, the petioles 1-2 cm. long, expanded into auriculate, clasping bases. Inflorescence corymbose, the heads borne at the tips of elongate leafless peduncles, the peduncles 4-10 cm. long, the heads narrowly campanulate 0.5-1.2 cm. in diameter. Phyllaries closely imbricated in 4-6 series, the outer series 2.5 mm. long, 0.5-0.8 mm. wide, glabrous to sparsely pilose. Ray flowers 15-30, the corolla tube 3-6 mm. long, the ligules 4-6 mm. long; disk flowers 25-40, the tube 4-8 mm. long. Ray achenes epappose, 2.2-3.8 mm. long, trigonous, glabrous or with a few sericeous hairs on the angles. Disk achenes 2.4-4.2 mm. long, ovate, compressed, densely sericeous. Inner pappus of numerous barbellate bristles 3.4-5.6 mm. long, the outer squamellate-setaceous, or of short barbellate bristles 0.3-0.5 mm. long.

Receptacle flat, white, alveolate, the partitions terminated by unequal chartaceous points.

TIME OF FLOWERING: February to December.

TYPE AND TYPE LOCALITY: *Mendez*, Guanajuato, Guanajuato, Mexico. Isotype (GH). Holotype Genève: Conservatoire et Jardin Botaniques (G). Not seen.

DISTRIBUTION AND HABITATS: Aguascalientes, Chihuahua, Guanajuato, Sinaloa, and Sonora, Mexico. Sandy soil, milpas, waste places and roadsides.

Heterotheca leptoglossa is an infrequently collected species. It has been confused with *H. latifolia* but is differentiated from the latter by its narrowly lanceolate leaves and corymbiform inflorescence. It is most closely related to *H. inuloides*, from which it is distinguished by its annual habit, narrow leaves, smaller capitulae, and linear phyllaries.

Representative specimens. MEXICO: **Aguascalientes:** Pesa Calles, *Shreve 9279* (GH). **Chihuahua:** Guicorichi, Rio Mayo, *Gentry 1947* (F, GH, MO, NY, PH, US). **Guanajuato:** San Miguel Allende, *Kenoyer 2178* (NY). **Sinaloa:** Choix, *Goldman 252* (GH, NY). **Sonora:** Alamos, *Goldman 289* (GH, US).

4. **H. chrysopsidis** DC., Prod. 5: 317. 1836

Perennial aromatic herbs, 25-75 cm. tall, branching from a woody caudex 2.5 cm. in diameter. Stem striate, slender, hispid to pilose, the hairs up to 2.5 mm. in length. Leaves ovate to elliptical, entire to serrate, 0.8-4 cm. long, 0.6-3 cm. wide, pilose on upper and lower surfaces, the veins prominently raised. Lower and middle cauline leaves petiolate, the petioles 1.5-4 cm. long, expanded into auriculate clasping bases. Cauline leaves becoming progressively smaller upwards, 0.4-2 cm. long, 0.2-1 cm. wide, sessile, serrate to entire. Inflorescence paniculately corymbose, the heads borne at tips of long flowering branches, the involucres 1-2 cm. wide, 0.5-1.2 cm. high, the involucres hemispheric to broadly campanulate. Phyllaries in 4-6 series, the outer series 2-3 mm. long, the inner series 6-9 mm. long, sparingly pilose. Ray flowers 15-30, the corolla tube 4-5 mm. long, the ligules 3-8 mm. long; disk flowers 30-50, the tube 4-7 mm. long. Ray achenes 1.5-2.5 mm. long, epappose or with a few setaceous bristles, trigonous, glabrous or with a few sericeous hairs on the angles. Disk achenes 2.5-4.0 mm. long, ovate, compressed, densely sericeous. Inner pappus of numerous barbellate bristles 6-9 mm. long, the outer series squamellate-setaceous, or of short barbellate bristles 0.2-0.4 mm. long. Receptacle flat, white, alveolate, the partitions terminated by unequal chartaceous points.

TIME OF FLOWERING: February to December.

TYPE AND TYPE LOCALITY: *Berlandier 109* "Circa Saltillo," Mexico. Isotypes (F, GH, NY, PH); photographs of holotype (F, US). Holotype, Genève; Conservatoire et Jardin Botaniques (G). Not seen.

DISTRIBUTION AND HABITATS: Saltillo east to southern Nuevo León, Mexico. Sandy soils, fields, and roadsides, 1,000 to 3,000 feet.

De Candolle's (1836) description of *H. chrysopsidis* states that the ray achenes bear pappi. This characteristic led him to consider the species to be intermediate between *Heterotheca* and *Chrysopsis*. He described *Heterotheca* Section 1, *Chaetactis*, containing only this species. An examination of isotypes (F, GH, NY, PH) show that the character was not present throughout the type collection. In specimens of *H. chrysopsidis*, as in most other species, one finds a crown or a few caducous bristles present on the ray achenes. The characteristic is not distinctive enough to be used as a species character, or as a sectional character.

Representative specimens. MEXICO: **Coahuila:** Parra, *Johnston 7707* (GH); Saltillo, *Palmer 492* (GH, NY, PH, US). **Nuevo León:** Galeana, *Chase 7670* (F, GH, MO, NY); 6 mi. below Iturbide, *Shreve and Tinkham 9788* (GH); Monterrey, *Palmer 481* (GH). **Tamaulipas:** San Jose, *Bartlett 10277* (GH, US).

5. **H. subaxillaris** (Lam.) Britton & Rusby, Trans. N. Y. Acad. Sci. **7:** 10. 1887

Annual or biennial aromatic herbs, procumbent to one m. tall. Stem striate, slender, scabrous to strigose to hispid, the hairs up to 2 mm. long. Leaves ovate to elliptical or lanceolate, entire to dentate to serrate, 1-5 cm. long, 0.4-1.5 cm. wide, scabrous on both surfaces. Cauline leaves 0.3-1.8 cm. wide, 1-2.5 cm. long, becoming progressively smaller upward, sessile, serrate to entire. Lower cauline leaves petiolate, the petioles 1-2 cm. long with enlarged auriculate-clasping bases often present. Inflorescence a loosely spreading or divaricate corymbose panicle; terminal involucres 0.6-1.5 cm. wide, 4-8 mm. high, campanulate to hemispherical. Phyllaries in 4-6 series, the tips villous, the inner series 4-8 mm. long, glabrous on inner face, bearing a tuft of short, thick hairs on outer face, the outer series 1-3 mm. long, glabrous on inner surface, bearing a well defined tuft of short thick hairs on outer face. Ray flowers 15-35, the corolla tube 2-4 mm. long, the ligule 3-5 mm. long; disk flowers 35-40, the tube 2-3 mm. long, glabrous. Ray achenes 1.6-3.1 mm. long, trigonous, epappose, glabrous or slightly sericeous. Disk achenes 1.4-3.0 mm. long, obovate, compressed, densely sericeous. Pappus of two series, the inner series of numerous barbellate bristles, 3.8-5.5 mm. long, reddish brown to white, the outer series squamellate-setaceous or of short barbellate bristles 0.2-0.4 mm. long, white or occasionally reddish brown. Receptacle flat, white, alveolate, the partitions terminated by unequal chartaceous points.

5a. **H. subaxillaris** var. **subaxillaris**

Inula subaxillaris Lam., Encyc. Méth. Bot. **3:** 259 col. 2. 1789.
Inula punctata Muhl., Cat. 76. 1813.
Inula scabra Pursh, Fl. Amer. Sept. **2:** 531. 1814.

Heterotheca lamarckii Cass., Dict. Sci. Nat. **21:** 131. 1821.
Chrysopsis scabra (Pursh) Ell., Sk. **2:** 339. 1823.
Heterotheca scabra (Pursh) DC., Prod. **5:** 317. 1836.
Stelmanis scabra (Pursh) Raf., Fl. Tellur. **2:** 47. 1836.
Chrysopsis lamarckii (Cass.) Nutt. Trans. Am. Philos. Soc., Ser. II, **7:** 315. 1841.
Heterotheca scabra, alpha calycium Torr. & Gray, Fl. N. Am. **2:** 251. 1843.
Heterotheca scabra, beta nuda Torr. & Gray, Fl. N. Am. **2:** 251. 1843.

Habit erect, leaves serrate, lateral veins prominent.

TIME OF FLOWERING: July to November, New Jersey to Georgia; throughout year along Gulf Coast.

TYPE AND TYPE LOCALITY: *D. Walter,* Carolina. Muséum National d'Histoire Naturelle, Paris (P). Photograph, Dr. G. H. M. Lawrence, Bailey Hortorium.

DISTRIBUTION AND HABITATS: Atlantic and Gulf Coasts from Delaware to northeastern Mexico. Sand dunes, beaches, fields and roadsides.

Shinners (1951) has dealt with the nomenclatural complexities of this species in some detail. For this reason this paper will deal quite briefly with the nomenclatural history.

Lamarck's (1789) description is somewhat vague and on its own would scarcely distinguish this species from several others in related genera. No indication is given as to where he acquired his specimen. The type specimen (P) bears only the notation "Walter, Carolina" and the reference to the Plukenet plate. This plate is not sufficiently detailed to make positive the identification of the species illustrated. Although unable to acquire the type on loan, I was able to make a positive identification of the type through the cooperation of Dr. Porterès of the Muséum National d'Histoire Naturelle and Dr. G. H. M. Lawrence, Bailey Hortorium, Ithaca, New York. Dr. Porterès sent portions of the type for study and compared material sent to him with the type, thus settling many questions. Dr. Lawrence kindly loaned me a photograph of the type which allowed a comparison of the habit of the type with specimens from herbaria in the United States. The results of this study showed that the type of *Inula subaxillaris* Lam. is a *Heterotheca* and is properly the type of the species now known as *Heterotheca subaxillaris* (Lam.) Britt. & Rusby. The suspicions of Cassini (1821) and De Candolle (1836) that the type of *Inula subaxillaris* was not a *Heterotheca* are thus shown to be baseless.

Inula punctata Muhl. (1813) referred to by Elliott and De Candolle as a synonym of *Inula scabra* Pursh is a *nomen nudum* and need not be considered for this reason, as well as for its lack of priority.

Inula scabra Pursh (1814) is illegitimate under Article 60 of the Rules of Nomenclature, since he cited *Inula subaxillaris* Lam. as a synonym. *Chrysopsis scabra* (Pursh) Ell. (1823), *Heterotheca scabra* (Pursh) DC. (1836) and *Stelmanis scabra* (Pursh) Raf. (1836) are all transfers of Pursh's illegitimate epithet and consequently are also illegitimate. De Candolle erroneously attributed the epithet to Nuttall (1818) in his transfer. Nuttall does not mark this species with an asterisk, as he did his own, and though there is no reference to Pursh under the species, he does comment in the introduction to Volume 1 (p. vii), "A brief Catalogue of the species is offered, which may be considered as supplementary to the recent and extensive Flora of North America by Frederick Pursh." It can be concluded therefore that Pursh is the author of the name.

In his description of *Heterotheca lamarckii*, Cassini (1821) cited *Inula subaxillaris* as a synonym and thus this name is also illegitimate according to Article 60. The binomial *Chrysopsis lamarckii*, created by Nuttall's (1818) transfer of this epithet, is also illegitimate.

The presence or absence of a crown on the ray achene is a character which not only occurs sporadically throughout most colonies, but one which may appear in either form in different heads of the same plant. The geographic distribution given by Torrey and Gray (1843) was not found in the large number of specimens examined in the course of this study. Under these conditions, both varieties *calycium* and *nudum* are considered ephemeral variants not worthy of formal recognition.

It is interesting to note that the transfer of the name of the type species to the genus *Heterotheca* as *H. subaxillaris* did not occur until seventy years after the description of the genus.

Representative specimens. **New Jersey:** Camden Co.: Camden, *Parker* (GH). **Pennsylvania:** Navy Yard, Philadelphia, *Canby* (F, NY). **Delaware:** New Castle Co.: *Wood* (US); Sussex Co.: *Williamson* (PH).

Virginia: Princess Anne Co.: Cape Henry, *Egler 40-245* (NY). **North Carolina:** Carteret Co.: Bogue, *Godfrey 5836* (GH, US); New Hanover Co.: Carolina Beach, *Batchelder* (GH). **South Carolina:** Beaufort Co.: *Cuthbert* (NY); Charleston Co.: Isle of Palms, *Clausen & Trapido 3574* (CU, NY, UC); Georgetown Co.: South Island, *Godfrey & Tryon 1565* (CU, F, NY, UC, US). **Georgia:** Chatham Co.: *Githens* (PH); Decatur Co.: *Brinson, Thorne 7636* (CU); Glynn Co.: Sea Island, *Cronquist 5436* (NY, US). **Florida:** Alachua Co.: Gainesville, *Demaree 10160* (CU); Brevard Co.: Rock Ledge, *Bartram* (PH); Collier Co.: Marco, *Deam 60577* (SMU); Dade Co.: Buena Vista, *Moldenke 5533* (NY); Duval Co.: Jacksonville, *Curtis 1358* (CU, F, KANU, NEB, NY, P, PH, SMU, US); Franklin Co.: St. George Island, *Gauman* (NY, PH, UC); Gulf Co.: St. Vincent, *Tracy 6359* (CU, NEB, NY, US); Hernando Co.: Brooksville, *Jones 28* (CU, US); Hillsborough Co.: Davis Island, *Perkins 860* (CU); Lake Co.: Eustis, *Nash 1718* (CU, F, NEB, NY, P, PH, UC, US); Lee Co.: Fort Meyers, *Standley 139* (F, NY, PH, US); Levy Co.: Cedar Keys, *Miller 333* (US); Liberty Co.: 6 mi. E. Appalachicola, *Sargent 6238* (SMU); Orange Co.: Lake Jovita, *O'Neill* (US); Palm Beach Co.: Gulfport, *Pilsbury* (CU); Putnam Co.: *Johnson and Barnhart 2316* (NY); St. Johns Co.: Anastasia Island, *Perkins 861* (CU); Volusia Co.: Tampa, *Degener 5182* (NY). **Alabama:** Mobile Co.: *Mohr* (US). **Mississippi:** Hancock Co.: *Demaree 29612* (TEX); Harrison Co.: *Bartram* (PH). **Louisiana:** Cameron Parish: *Correll 9607* (NY). **Texas:** Cameron Co.: Del Mar, *Cory* (GH); Chambers Co.: *Tharp 3191* (TEX, US); Galveston Co.: *Fisher 654* (NY); Kleberg Co.: Padre Island, *Cory 49139* (NY); Nueces Co.: Mustang Island, *Warnock 21340A* (TEX).

5b. **H. subaxillaris** var. **procumbens** var. nov.

Planta prostrata, foliorum laminis integris pauciserratisque, nervis lateralibus obscuris.

Habit procumbent, the leaves entire to remote-serrate, the lateral veins obscure.

TIME OF FLOWERING: Throughout the year.

TYPE AND TYPE LOCALITY: *R. M. Harper 3801,* on flattish dunes about a mile southwest of Dauphin Island Post Office, Mobile Co., Alabama, (GH). Isotypes (F, NY, PH, US).

DISTRIBUTION AND HABITATS: Eastern Florida to northeastern Mexico. Exposed beaches and drifting sand.

The type specimen was selected because it is typical of the variety and because it was distributed to a number of herbaria.

Representative specimens. **Florida:** Brevard Co.: Cape Canaveral, *Burgess 683* (NY). **Alabama:** Mobile Co.: 1 mi. southwest of Dauphin Island Post Office, *Harper 3801* (F, GH, NY, PH, US). **Mississippi:** Hancock Co.: Bay Saint Louis, *Munz* (CU); Harrison Co.: Mississippi City, *Lloyd & Tracy 532* (NY); Jackson Co.: Horn Island, *Tracy 4345* (NY). **Louisiana:** Cameron Parish: *Reed 218* (US); Saint Bernard Parish:

Breton Island, *Tracy* (F, GH, US). **Texas:** Cameron Co.: Padre Island, *Johnston 54205* (TEX); Brazoria Co.: Freeport Beach, *Killip 43295* (TEX, US); Galveston Co.: Galveston Island, *Turner 1748* (SMU); Nueces Co.: Corpus Christi, *Tharp, Johnson and Weber 48-109* (TEX). MEXICO: **Tamaulipas,** south of Rio Grande, *Leseur 469* (US).

6. **H. psammophila** sp. nov.

Annua aromatica 0.5-2.0 m. alta. Caulis robustus ca. 8-12 mm. diametro striatus hispidulus vel pilosus. Folia plus minusve pilosa; infirma ovata, serrata, 4.5-7.0 cm. longa, 3.0-5.5 cm. lata, petiolis 1-2 cm. longis basin versus auriculatis; foliis caulinis lanceolatis integris vel serratis, 2-9 cm. longis, 0.5-3.0 cm. latis. Inflorescentia paniculato-corymbosa; capitula pedunculos nudos terminantia. Involucrum 0.8-1.2 cm. altum, 1.3-1.7 cm. latum, rotundato- vel lato-campanulatum. Phyllaria 4-6-seriata pilosa denseque glandulosa, exteriora 4-5 mm. longa, interiora 8-12 mm. longa. Flores radiati 20-30, corollae tuba 3-7 mm. longa, achaenia trigona 2.4-3.8 mm. longa epapposa glabra vel margine minute sericea. Flores discoidei 25-45, corollae tuba 5-9 mm. longa, achaenia obovata compressa 2.6-4.2 mm. longa dense sericea; pappis interioribus pilis, 6-9 mm. longis, barbellatis, dilute ferrugineis, exterioribus squamellatis, setaceis, vel nitis barbellatis dilutis ferrugineis. Receptaculum planum album denticulato-alveolatum.

Annual, aromatic herbs, 0.5-2 m. tall. Stem robust, 8-12 mm. in diameter, striate, hispid to pilose, the hairs up to 2.5 mm. in length. Leaves ovate to lanceolate, entire to serrate, sparsely pilose on upper and lower surfaces. Lower cauline leaves ovate, the lamina serrate, 4.5-7.0 cm. long, 2.0-5.5 cm. wide, petiolate, the petioles 1-3 cm. long, expanded into auriculate clasping bases. Middle and upper cauline leaves lanceolate, entire to serrate, 2-9 cm. long and 0.5-3 cm. wide, becoming cordate above. Inflorescence paniculate-corymbose, the heads terminal on leafless peduncles, the heads 1.3-1.7 cm. wide, 0.8-1.2 cm. high, hemispheric to broadly campanulate. Phyllaries in 4-6 series, the outer series 4-5 mm. long, the inner series 8-12 mm. long, pilose and densely glandular. Ray flowers 20-30, the corolla tubes 3-6 mm. long, the ligules 3-7 mm. long, the disk flowers 25-45, the tubes 5-9 mm. long, glabrous. Ray achenes 2.4-3.8 mm. long, trigonous, epappose, glabrous or more commonly sparsely sericeous on the angles. Disk achenes 2.6-4.2 mm. long, ovate, compressed, densely sericeous. Pappus of two series, the inner series of numerous barbellate bristles, 6-9 mm. long, tan; outer series squamellate-setaceous or of barbellate bristles 0.2-0.6 mm. long, tan. Receptacle flat, white, alveolate, the partitions terminated by unequal chartaceous points.

TIME OF FLOWERING: July to December.

TYPE AND TYPE LOCALITY: *B. L. Wagenknecht 4824*, sandy soil along edge of roadside ditch, 1 mi. s. Sedona, Yavapai Co., Arizona, August 23, 1957. (KANU).

(to be continued)

CROTON SUAVEOLENS AND CROTON ABRUPTUS (EUPHORBIACEAE) OF WESTERN TEXAS AND NORTHERN MEXICO

MARSHALL C. JOHNSTON

The study of plants previously referred to *Croton suaveolens* Torrey (Ferguson, 1901: 43; Standley, 1923: 616) reveals that two species are involved, adding one more species to the eighteen reported for Texas (Johnston, 1959). The following key will serve to point up the differences.

Flowers monoecious (plants rarely appearing unisexual); racemes usually androgynous, and always terminal; internodes about a third as long as the mature subtending leaves, and petioles about a fourth to two-fifths as long as their blades; capsules 6-8 mm. long; seed 5.5-6.5 mm. long; stamens 14-16; staminate calyxes ca. 6 mm. across ..... *C. suaveolens* Torrey.

Flowers dioecious; staminate plants with terminal racemes; pistillate plants with axillary racemes; internodes about half as long as the mature subtending leaves; petioles about a tenth to a fifth as long as their blades; capsules 5.5-6 mm. long; seed 4.4-4.7 mm. long; stamens 9-12; staminate calyxes ca. 4 mm. across ..... *C. abruptus* M. C. Johnston.

Croton suaveolens Torrey, Bot. Mex. Bound. p. 194, 1859.

"On the Rio Grande," *Wright exs. 1804* (NY?; apparent isotypes seen; GH, US).

Low stellate-tomentose hemispheric shrubs 20-35(-50) cm. tall; taproot 4-18 mm. thick, woody, with a brown to black bark with shallow longitudinal fissures; stems many, much-branched, 1.5-8 mm. thick, the older ones glabrate with a thin fuscous minutely longitudinally fissured bark; leafy branches (yearling twigs) 1.5-3 mm. thick, 8-20 cm. long, terete, densely and shaggily pale grayish to yellowish stellate tomentose; internodes short, 0.2-1 cm. long, the leaves thus somewhat crowded toward the ends of the branches. Leaves alternate or occasionally nearly opposite (very rarely in a whorl of 3) near the base of the racemes; blades rather thick, obovate or ovate or broadly elliptical, 2.0-5.4 cm. long, 1.0-3.6 cm. broad, about twice or a little less than twice as long as broad, broadest near the middle, rounded, obtuse and apiculate or angled apically (90-120°), narrowed or rounded basally, entire marginally, densely and shaggily grayish stellate tomentose below, less densely tomentose and pale olive-green above; petioles 5-20 mm. long, stout and tomentose like the stems; stipules a little longer than the tomentum, stramineous (young) to brownish (mature), of 5-10 unequal glandular papillae each 0.2-0.5 mm. long and bearing a few stellate trichomes, arranged palmately on a thin disk ca. 0.3 mm. in diameter. Flowers monoecious; racemes terminal, generally androgynous, 1-2(-2.5) cm. long, stout, rather densely

flowered. Staminate flowers 4-12 at top of raceme; bracts 0.7-0.8 mm. long, linear, subulate, tawny, stellate-hairy with 2 glandular pinnate stipular lobes smaller than the main portion; pedicels 3-5 mm. long (to 8 mm. long says Ferguson, but Torrey says the flowers are sessile), stellate-tomentose, ascending; calyx stellate-tomentose, limb cupped, ca. 2 mm. across, the 5 sepals ovate, ca. 2 mm. long; petals tawny, thin, 5, spatulate or obovate, densely villous at least marginally and basally, slightly longer than and alternate with the sepals; glands rather small, tawny, ca. 0.2 mm. long, narrowly oblong; stamens 14-16 (Torrey says 12-14, but most plants show 16 in the field); filaments densely villous basally, mostly smooth above; center of flower raised and densely villous. Pistillate flowers 2-4 at base of raceme, often 2-3 maturing fruit on each raceme; raceme axis stout, buttressed; bracts tawny, stellate-hairy, usually 3-lobed, the lobing pinnate or appearing palmate, linear subulate, or the lateral (stipular) lobes glandular, the middle one ca. 1.2 mm. long; pedicels 1-2 mm. long, stout, apparently accrescent to 3-4 mm. long, erect; calyx stellate-tomentose, not at all accrescent, deeply 5-lobed, the sepals thick, united only at base, lanceolate or narrowly triangular acuminate, ca. 2.5 mm. long; petals reduced to mere stalked glandular papillae between the sepals; glands of the disk thin, narrow, elongate, brownish; ovary subglobose, densely stellate-tomentose; styles 3, 4-6 mm. long, bifid to the base, stellate-tomentose, the divisions slender, purplish brown and grooved adaxially. Capsules oblong to subglobose, truncate at both ends, obscurely 3-lobed apically, 6-8 mm. long, 6-8 mm. broad, usually longer than broad, densely and shaggily yellowish or whitish stellate-tomentose; columella (5-)6-7.5 mm. long, rather stout, abruptly broadened at the summit into 3 sharp projections. Seeds roundly oblong, apiculate, dorsiventrally flattened, 5.5-7 mm. long including caruncle, grayish mottled fuscous or black when fully mature, rather shiny, smooth or with microscopic roughening; caruncle reniform, whitish vesicular, 2.5 mm. wide, 1 mm. long.

In Texas these plants are known only from the immediate vicinity of Fort Davis in Jeff Davis County, from bluffs and grassy slopes of an old decomposing lava with a high sanidine content. Nine collections have been seen from that neighborhood, and numerous plants have been studied in the field there.

The Coahuilan collections are here cited: San Lorenzo canyon, 6 miles southeast of Saltillo, *E. Palmer 390*, Sept. 21-22, 1904 (US); Sierra de la Paila, *Purpus 5040*, Oct. 1910 (US); El Berrendo near Muzquiz, elev. 4000 ft., *S. S. White 1802*, July 13-16, 1939 (GH, US); 5 miles northwest of Puerto del Aire pass at the southern end of Sierra de la Encantada, *Stewart 1300*, Sept. 1, 1941 (GH); western slopes of Sierra del Carmen 10 kilometers east of Hacienda de la Encantada, *Stewart 1679*, Sept. 15, 1941 (GH); 9 kilometers south of Parras on Sierras Negras, *Stanford, Retherford & Northcroft 214*, July 3, 1941

(GH, MEXU); Sierra de la Madera, vicinity of La Cueva in Corte Blanco fork of Charretera canyon, elev. 5300-6500 ft., *I. M. Johnston 8955*, Sept. 11-15, 1941 (GH); Sierra de Santa Rosa, south of Muzquiz, *Marsh 1385*, July 14, 1938 (GH); Sierra del Pino, vicinity of La Noria, end of road from T. Armendariz north into the Sierra del Pino, *Johnston & Mueller 519*, Aug. 20-26, 1940 (GH).

Croton abruptus M. C. Johnston, new species.

Fruticulus ad 40 cm. alt., e radice terete oriens; caules 10-35 e corona crescentes; ramosissimi, ramulis frondosis subflavis, stellato-tomentosis; laminae foliorum ovatae ad elliptico-ovatas, 1-3(-4.5) cm. long., 0.5-1.5(-1.9) cm. lat., ca. 2 plo longiores quam latae, integrae, dense tomentosae, in superficie superiore minus dense; petioli 2-3(-4.5) mm. long.; stipulae 0.1 mm. long. glanduliformes; flores dioecii, staminei petaliferi, pistillati non petaliferi; racemi staminei terminales, 0.5-1 cm. long.; pistillati plerumque 2 flores habentes, 1-3 mm. long. ut videtur axillares, plerumque uno tantum ovario racemi maturescente; styli 3, usque ad basim bifidi; capsula globosa, 5.5-6 mm. long.; semen rotundo-ovatum, 4.4-4.7 mm. long. fuscum fulgens laeve; caruncula reniformis, ca. 0.8 mm. long.

Low, stellate tomentose shrubs 10-30(-40) cm. tall; taproots terete, 3-8(-13) mm. thick, occasionally branching but usually simple, slenderly napiform, with a dark brownish bark nearly smooth or with faint vertical lines; stems several to many (10-35) from the enlarged woody crown, ascending, terete, 1-3 mm. thick, 10-25(-35) cm. tall altogether, much-branched, the angles of divergence of the branches 10-40°; stems often not persistent more than one or two years and not acquiring a thick bark; oldest stems eventually with a gray to black faintly vertically fissured bark; leafy branches yellowish, densely and somewhat shaggily stellate-tomentose, the internodes a sixth to about as long as their subtending leaves. Leaves alternate; blades ovate to elliptic-ovate, 1-3(-4.5) cm. long, 0.5-1.5(-1.9) cm. wide, about twice as long as broad or a little more, widest just below the middle, apically acute or rounded, basally rounded or occasionally narrowed, marginally entire, densely and shaggily canescent stellate-tomentose below, less densely tomentose and greener above; venation pinnate, but often obscured by the tomentum, the midvein prominent beneath, the laterals 5-6 on each side diverging at angles of 40-50°; petioles stout, densely shaggily stellate-tomentose, 2-3(-4.5) mm. long, much shorter than the blades; stipules 0.1 mm. long, dark brown or black, glabrous, shiny, papillose-glandular, obtuse-pyramidal, entire, usually hidden by the trichomes. Flowers dioecious. Staminate flowers several in slender terminal racemes 0.5-1 cm. long, the axis pubescent like the stem with internodes ca. 1 mm. long; pedicels 1 mm. long or less, stellate-tomentose, subtended by triangular-ovate acute bracts less than 1 mm. long; calyxes hemispheric or broadly campanulate, whitish or yellowish stellate-tomentose, with 5 (rarely 4) triangular acute

lobes, 2 mm. from the attachment of the pedicel to the tip of the lobe, the limb comprising about half that length; petals 5 (rarely 4), narrowly oblanceolate or somewhat unguiculate, alternate with calyx lobes and reflexed between them at anthesis, 1.8-2 mm. long, hyaline, whitish; glands 5, orangish, 0.2 mm. long, oblong or rounded, opposite the calyx lobes; stamens 9-12 (usually 11 counted in the field), the filaments glabrous and strongly inflexed in bud, 1.9 mm. long; center of flower raised and densely villous. Pistillate flowers usually 2, rarely 3, in racemes 1-3 mm. long; racemes actually terminal and quickly surpassed by a branch from the axil of the subtending leaf, but appearing therefore nodal or axillary; only one flower per raceme maturing fruit; bracts simple, subulate, 0.5-1 mm. long, stellate-tomentose abaxially; pedicels absent or very short; calyx deeply 5-lobed, shaggily stellate-tomentose outside, the limb cupped, ca. 1.7-1.9 mm. across, sepals ca. 1 mm. long, not at all accrescent, acute; glands 5, opposite the sepals, narrowly elongate, purplish brown; petals absent or only the merest glandular rudiments present; ovary globose, densely and shaggily stellate-tomentose; styles 3, ca. 1.5-2 mm. long, each bifid to the base, the divisions slender, divergent, purplish-brown, grooved ventrally, stellate-tomentose dorsally at the base. Capsules globose or somewhat 3-lobed toward the summit, densely and shaggily whitish or yellowish-green stellate-tomentose, 5.5-6 mm. long, columella 3.8-4.5 mm. long. Seeds plump, rounded, ovoid, slightly compressed ventrally, grayish or fuscous mottled black, shiny, smooth or with obscure irregular low rounded tubercles microscopically, 4.4-4.7 mm. long, including the caruncle; caruncle prominent, broadly reniform, whitish vesicular, ca. 0.8 mm. long. TYPE: Presidio County, Texas, limestone hill a quarter of a mile north of Solitario Peak, in lechuguilla, lat. 29°28′ N. by 103°50′ W., alt. 4600 ft., *M. C. Johnston 3441* (pistillate), Oct. 12, 1958 (holotype, SRSC; isotypes, TEX, US, GH, et al.). The staminate paratypes, from the same locality, are *Johnston 3440* (same herbaria).

These plants do not show much restriction as far as soils are concerned, having been found on limestone, novaculite (bedded cherty rock), and basic igneous crystallines; their elevational range is about 3800 to 4800 feet; they occur in desert scrub. All the specimens seen other than the type are cited.

TEXAS. **Brewster County:** without locality other than county, *Cory 1881*, April 25, 1928 (GH); 18.5 miles south of Marathon, *Cory 6910*, Sept. 6, 1933 (GH); frequent perennials, crevices, igneous rocks, Agua Fria Mountain, alt. 4500 ft., *B. L. Turner 1323*, July 31, *1949* (SRSC, SMU, pistillate only); infrequent, protected canyon in novaculite hills 16 miles south of Marathon, alt. 3800 ft., *Warnock 6121*, June 29, 1947 (SRSC, staminate, pistillate on same sheet); frequent perennial, rocky novaculite hills, 21 miles south of Marathon, alt. 3850 ft., *Warnock*

15895, April 1, 1958 (SRSC, staminate only); novaculite hills 12 miles south of Marathon, elev. 3900 ft., abundant low shrubs, *M. C. Johnston 3605*, *3606*, *3607* (pistillate, sun and shade forms), and *3608*, *3609*, *3610* (staminate, sun and shade forms), Nov. 5, 1958 (SRSC, et al.). **Presidio County:** small, west-flowing canyon in Glen Rose limestone, northwest of Solitario Peak, lat. 29°27½′ N. by 103°51½′ W., alt. 4200-4300 ft., *M. C. Johnston 3463*, Oct. 12, 1958 (SRSC, pistillate).

CHIHUAHUA: rocky hills near Chihuahua, *Pringle 140*, May 23, 1885 (GH, US); Santa Eulalia hills about 13 miles east-southeast of Chihuahua, *Wilkinson s. n.*, July 30, 1885 (US); vicinity of Chihuahua, alt. ca. 1300 meters, *E. Palmer exs. 73 & 77*, April 8-27, 1908 (GH, US); vicinity of Chihuahua, alt. ca. 1300 meters, *E. Palmer exs. 368*, June 5-10, 1908 (GH, US); Sierra Azul (Sierra Mapula) ca. 15 miles south-southeast of Chihuahua, shrub at base of cliff, elev. 1600-1700 meters, *F. W. Pennell 18664*, Sept. 10, 1934 (US, PH, MEXU).

During the preparation of this paper, Dr. Barton H. Warnock of Sul Ross State College, Alpine, Texas, has given generously of his incomparable knowledge of the flora of western Texas. I am further indebted to the staffs of the herbaria visited (cited above according to Lanjouw and Stafleu, 1959) for their help, and to Hannah Croasdale of Dartmouth College for work on the Latin diagnosis. — THE UNIVERSITY OF TEXAS, AUSTIN.

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DATES OF PUBLICATION OF GÄRTNER'S DE FRUCTIBUS ET SEMINIBUS PLANTARUM

GEORGE K. BRIZICKY

Despite extensive research in botanical bibliography, there are still many works, the exact publication dates of which are doubtful. Among these works is Gärtner's *De fructibus et seminibus plantarum*. Below are some notes which it is hoped will clarify the dates of appearance of this important taxonomic reference.

Pritzel (Thesaurus lit. bot. ed. 2. p. 116. 1872) cites the two volumes of Gärtner's work as appearing in 1788 and

1791 respectively. Van Steenis-Kruseman and Stearn in *Flora Malesiana* (Ser. 1. 4(5) : p. CLXXXIII. 1954) refer to Burtt's study (Kew Bull. p. 148. 1951) and merely state that volume 1 of *De fructibus* antedates part 1 of volume 3 of Lamarck's *Encyclopédie méthodique* (1789) and that volume 2 of Gärtner precedes part 2 of volume 3 of Lamarck (1791-1792). Actual publication dates for Gärtner's work are not cited. Burtt (l. c.) presents proof for the above statement and quotes 1789 as the publication date for volume 1 of *De fructibus* and 1791 as the issue date for volume 2 of Gärtner's work. Although 1789 is the correct year of effective publication for volume 1 of Gärtner, there are certain circumstances surrounding the issuance of this volume which should be brought to light. This, to avoid discrepancies in the future. The story of the publication of volume 1 of *De fructibus*, based on various announcements and reviews, is about as follows:

In the first quarter of 1788, the Cotta Booksellers of Tübingen, agents for Gärtner, announced the appearance of the first volume of Gärtner's *De fructibus* in the "Leipziger Oster-Messe Verzeichnis."

On 10 August 1788, the Cotta Booksellers advised the "Intelligenzblatt der Allgem. Literatur-Zeitung"[1] (No. 44. p. 377-378) as follows: "*Der erste Theil der im letztern Leipziger OM. Verzeichnis angekündigten Werks des Hrn. D. Harter* (sic!) *de fructibus et seminibus plantarum 3 Alph. in gr. 4 mit Kupf. wird, verschiedener Hindernisse wegen, erst in einigen Monaten fertig.*" A very brief review of this volume, probably written by Gärtner, was added.

In the October 1788 issue of "Observations et mémoires sur la physique, l'histoire naturelle . . ." (33: 324-325), a review of volume 1 of *De fructibus* appeared. The report was relatively brief, Gärtner was misspelled as Gaestner, and 14 chapters comprising 384 pages were cited correctly.

On 1 March 1789, in the "Intelligenzblatt" (No. 34. p. 267-268) cited above, the Cotta Booksellers entered an an-

[1] The publication known as the "Allgemeine Literatur-Zeitung" was issued in two sections: the "Zeitung" proper, and the "Intelligenzblatt" or intelligencer. The latter was devoted to announcements of new books.

nouncement identical to that of 10 August 1788. Here Gärtner was spelled correctly.

A review of volume 1 of *De fructibus* appeared on 28 May 1789 in the "Göttingische Anzeigen von gelehrten Sachen" (No. 85. p. 850-854). The "Allgemeine Literatur-Zeitung" (No. 246. p. 417-424) also carried a review in the 15 August 1789 issue.

Persuing the above, the reader can see from the announcements of Cotta Booksellers, and the review in the "Göttingische Anzeigen," that the completion of the first volume of *De fructibus*, and its appearance at booksellers, did not occur until April or early May 1789.

The review in "Observations et mémoires" (October 1788) is puzzling. However, it seems to be easily explainable as follows:

(1) It appears that the text for volume 1 of *De fructibus* had already been printed at the time of the review in the "Observations," as the reviewer cites the exact number of pages — 384.

(2) It is probable that Gärtner expected completion of volume 1 by that time (Cotta announcement of 10 August 1788) and wrote the above-mentioned review (perhaps "announcement"?) for the "Observations."

(3) Whatever obstacles prevented the appearance of *De fructibus* as twice announced by Cotta in 1788, probably pertained to the issuance of the copper engravings, not the text.

It is highly improbable, however, that the text to the first volume became accessible to botanists before completion of the volume, i. e., before April or early May 1789. Therefore, the latter date must be accepted as the date of effective publication for Gärtner's new taxa in the first volume of *De fructibus*.

Both Burtt (Kew Bull. 1951) and Pritzel (Thesaurus lit. bot. ed. 2. 1872) mention 1791 as the publication date for volume 2 of Gärtner's *De fructibus*. This date is only partially correct as the volume was published in installments.

On 26 August 1790 Gärtner announced in the "Intelligenzblatt der Allgem. Literatur-Zeitung" (No. 116. 6. 953-954): "*Den zweyten Theil aber gedenke ich in drey Lieferungen*

auszugeben, woran die erste, von 1 Alph. und 40 Kupf. innerhalb zwei Monaten; die zweyte, von ungefähr gleicher Bogenzahl mit 37 Kupf. gleich nach dem neuen Jahr; und die dritte, von etwa 1 ½ Alph. nebst 23 Kupf. mit oder bald nach der nächsten Oster-Messe um so gewisser erscheinen soll, als von den sämtlichen Kupfer-Platten bereits schon 66 Stück fertig sind."

A review of the incomplete second volume of *De fructibus* appeared on 25 August 1791 in the "Göttingische Anzeigen von gelehrten Sachen" (No. 136. p. 1367-1368) where we read: "*Von dem vortrefflichen Werke des kürzlich verstorbenen Prof. Gärtner haben wir noch 1790 das sechste und siebente S. 1-184, Pl. 80-119. und 1791 das achte und neunte Hundert S. 185-352. Pl. 120-156. erhalten . . .*"

In the announcement of Cotta which appeared in the "Intelligenzblatt der Allgem. Literatur-Zeitung" (No. 24. p. 186) on 23 February 1791, Centuria 6 and 7 of *De fructibus* were listed among books published after Easter 1790, and Centuria 8-10a among books to appear before Easter 1791.

The edition of Centuria 10 had apparently been delayed and this part of Gärtner's work seems to have appeared not earlier than in the second half of 1791. The earliest review of the complete second volume *De fructibus*, known to the writer, is that in the "Allgemeine Literatur-Zeitung" (No. 98. p. 97-103) of 16 April 1792.

We can conclude therefore, that Gärtner's work, *De fructibus et seminibus plantarum* was published as follows:

Volume 1:		April or early May 1789
Volume 2:	Centuria 6 and 7: 1-184, pl. 80-119.	October or November 1790
	Centuria 8 and 9: 185-352, pl. 120-156.	Probably April, but not later than early August 1791
	Centuria 10: 353-520, pl. 157-180.	Probably the second half of 1791.

— S. J. RECORD MEMORIAL COLLECTION, SCHOOL OF FORESTRY, YALE UNIVERSITY, NEW HAVEN, CONNECTICUT.

THE COMING OF AGE OF AMERICAN BOTANY.[1] — Asa Gray was instrumental in creating two big revolutions which took place in American botany during the nineteenth century. As a young graduate, while still a country doctor, together with his friend and teacher John Torrey, he championed in this country the natural systems of Lindley, De Candolle, and others, over the artificial Linnean system which Amos Eaton had divulgated and maintained. The final adoption by the botanical world of the natural systems brought Gray into prominence.

The second big turning point in Gray's career came with Charles Darwin and the "Origin of Species". Gray had been Darwin's American correspondent for some years before the publication of the "Origin" and had supplied Darwin with important facts especially concerning the Asiatic-American floristic relationships. In turn he became one of the few members of the Darwinian "inner circle" and was introduced to evolutionary theory before the rest of the world. This made Gray the natural candidate to explain evolution to the American public. In the many discussions and debates which took place, Gray presented an objective view of Darwinism, but without ever becoming a "convert" in the manner of Thomas Huxley. When the final smoke clouds of the Darwinian debates had been lifted, Gray emerged as the undisputed patriarch of American botanical science.

But undoubtedly Gray's main contribution was his daily work of classifying the material of the botanical explorations of the West which he and Engelmann were fostering. It was largely this tedious, time consuming work, which brought the center of gravity of American botany from Kew to Harvard and changed the flow of American material from its established lines to the Old World, to a young and vigorous center in the New World.

A. Hunter Dupree has presented a dynamic view of the unfolding of botanical history around Gray's life. Gray's first years when still an amateur collector, his friendship

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[1] ASA GRAY by A. Hunter Dupree, 505 pp., 25 figures. 1959. The Belknap Press of Harvard University. $7.50.

with Torrey, his rise in scientific stature, and his eventual collaboration in the North American Flora are very well described. The hardships that Gray had to undergo in order to become a true full-time botanist in a nation which was itself undergoing the labors and pains of growth are fully expressed. The author also acknowledges the debt which Gray and American botany in general owe to Europe and the reader is made fully aware that independence and self rule came to American botany through evolution and growth, and that Gray always remained in touch with Kew and the continent, assimilating all that was new and relaying it to the American world.

An important facet in Gray's life which has not been forgotten by Dupree, is Gray's ability as a writer of Manuals and textbooks of botany. It will be interesting therefore for the reader to learn that these books, which played such an important role in botanical teaching during more than half a century, were often born to ease the poverty of its author, or, as in the case of the famous "Manual", to prevent a poor and unscientific tome from filling the gap of need. It speaks well of Gray's ability in all aspects of botany, that under such circumstances he managed to produce work of such high quality.

The book is well printed and presented, and the few illustrations are adequate. The style is pleasant, neither superficial nor too academic, and the book will make good reading for the botanist and the layman.

Undoubtedly in a book of this kind many things had to be left out. The author, I feel, has sacrificed the personal aspects in favor of the scientific ones, especially in the long discussion over Darwinism and the Darwinian debates. Nevertheless enough of Gray the man is there to appreciate Gray the botanist in his full worth. — OTTO T. SOLBRIG, GRAY HERBARIUM.

Volume 62, No. 734, including pages 31-60, was published February 24, 1960.

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JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

REED CLARK ROLLINS, Editor-in-Chief

ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
CARROLL EMORY WOOD, JR.
IVAN MACKENZIE LAMB
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Vol. 62 April, 1960 No. 736

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

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Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

Rhodora

JOURNAL OF THE
NEW ENGLAND BOTANICAL CLUB

Vol. 62 April, 1960 No. 736

RECENT CHANGES IN SOME RHODODENDRON COLONIES IN MAINE AND NEW HAMPSHIRE

A. R. Hodgdon and Radcliffe Pike

That *Rhododendron maximum* leads a precarious existence in its few and scattered stations in northern and central New England is so evident that it does not need to be reaffirmed here. Changes in the environment might be expected therefore to exert a considerable effect on the species. The purpose of this paper is to document these effects in a number of colonies which we have had under observation during recent years and particularly to point out the extreme sensitivity of Rhododendron to certain kinds of disturbance. At the outset we can state that, of the many instances of decline of Rhododendron stands that have come to our attention, not one in either Maine or New Hampshire can be attributed mainly to *direct* despoliation by man.

R. maximum lends itself uniquely to a study involving a recording of the areal extent of stands because, being singularly unusual in appearance as well as uncommon, it has attracted much attention and comment since comparatively early times. Also the fact that it occurs by itself, dominating its habitat makes it easy and tempting to estimate the size of colony. Thus there are many statements in the literature giving the sizes of stands when first reported and often we have found local inhabitants familiar with the colonies that we have visited, well prepared in most instances to tell us the acreage of the colony at some earlier time. Of course it is not safe to rely too precisely on such data, but trends

Published with the approval of the Director of the New Hampshire Agricultural Experiment Station as Scientific Contribution No. 250.

are certainly indicated that are borne out by our own observations during successive visits or by reports in the literature.

Fluctuations in colony at Lexington, Maine. — F. H. Cowan[1] reporting in 1899 that this colony covered "over half an acre" made the additional comment "It is said that as early as 1845, one Nathan Safford, who lived near the pond, found these strange flowers and that, at that time, only a few square rods were covered by the plants." Mr. C. H. Knowlton visited the colony on August 20, 1949 and reported[2] as follows: "The shrub was discovered in 1845 by one Nathan Safford who lived nearby and the stand has spread from a few square rods to nearly two acres. About a quarter of this area is now full of dead shrubs, perhaps due to change in water-level."

We have visited this area on two occasions the earlier in November 1951 the more recent on July 19, 1954. In 1951 it seemed to us that the colony was vigorous and showed no more striking signs of deterioration, except in size, than were apparent to Knowlton two years before. By pacing, we calculated the stand to be about 200 feet long by 150 feet wide, the area thus to be about three quarters of an acre. Some of the difference in size as noted by Knowlton and ourselves may be due to errors in estimation but some undoubtedly may be laid to the killing off of plants at the periphery of the colony. In 1954 the stand was reduced in size to much less than half of its 1951 size. The undoubted agents of destruction were deer which apparently have yarded in the area and had nipped off since 1951 an estimated one-half to two-thirds of the shoots around the colony, leaving untouched, at that time, only a small part of the stand at its center. Earlier nipping by deer occurred at heights of about 3-4 feet, the probable depth of snow in midwinter. More recent foraging had taken place on stems about a foot high. In either case virtually all stems thus mutilated lost all of their foliage and subsequently died leaving considerable areas of naked dead stems where luxuriant growth was

[1] Cowan, F. H., Rhododendron maximum in Somerset County, Maine. Rhodora **1:** 55, March 1899.

[2] Knowlton, C. H. Rhododendron maximum in New England, Rhodora **52:** 215-218, Sept. 1950.

present in 1951. This attractiveness of rhododendrons for deer has been shown in other areas.[3,4] We noted in 1954 considerable reproduction by seedlings among the living and dead plants which shows that the colony could perpetuate itself once the deer cease their depredations.

Sanford, Maine colony. — Knowlton loc. cit. p. 216 wrote "three acres are covered" by the rhododendrons. It is not certain where or when he obtained this information. But as a result of several visits in recent years, the first on July 7, 1955, we estimate the total area covered by both dense growth and scattered plants as something like five acres. Considerable reproduction of seedlings was noted particularly at the edge of the colony on the east where new plants were filling in between older clumps and the entire colony was expanding its area somewhat. The colony at present lies almost entirely on a slope to the north of which is a swamp or wet sedge-meadow which seems to be developing into a red maple swamp. Some rhododendron seedlings in recent years are appearing beyond the parent plants at the edge of the swamp.

While of a less spectacular nature than at Lexington, Maine, the change in extent of coverage of the Sanford, Maine colony is mentioned here to show that rhododendron stands can spread when environmental conditions are suitable.

Albany, New Hampshire colony at Bald Hill. — This small but well known stand was first reported by St. John[5] in 1916 who wrote of it as follows: "the trees fifteen feet in height made a solid stand over an acre of ground." In 1938 the late Mr. Elmer Littlefield of Conway, who at that time owned land near the rhododendron tract guided the senior author into the area. On April 3, 1954 Messrs. Frederic Steele and Alexander Lincoln, Jr., visited the colony and recorded their observations and on November 15, 1955 the present authors visited the tract to obtain seeds and to note the condition

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[3] Forbes, E. B. and S. I. Bechdel, Mountain laurel and Rhododendron as foods for white-tailed deer. Ecol. 12:323, 1930.

[4] Forbes, E. B. and L. O. Overholts, Deer carrying capacity of Pennsylvania woodland. Ecol. 12:750, 1931.

[5] St. John, Harold. Additional notes on Rhododendron maximum in New Hampshire. Rhodora 18:73-74, April, 1916.

of the stand. The senior author's impression from the 1938 visit is of an extensive and lush growth of rhododendrons in a fairly open forest of mixed conifers and hardwoods. Steele and Lincoln in their April 1954 notes (unpublished) comment on rhododendrons being stunted and in poor condition above the ledges and beneath the developing forest.

Our visit in November 15, 1955 showed the rhododendrons to have almost completely disappeared under the very dense blanketing growth about 15-20 feet high of dominant *Tsuga canadensis* with scattered trees of *Picea rubens*. Occasional weak plants still persisted under the conifers. The colony was reduced essentially to some straggling plants somewhat unevenly covering an area of ledge about 60 feet wide by 200 feet long. Here the rhododendrons were associated with deciduous trees chiefly and were reproducing satisfactorily by seedlings in 1955. The reduction of this colony to about one-third of its earlier size resulted from the removal of the bigger trees from much of the stand. The plants here have suffered first from their complete exposure by cutting or removal of protecting trees, and subsequently by their being shaded out by overtopping conifers.

Pittsfield, New Hampshire colony. — On two occasions we have searched in vain for a small stand of rhododendrons in Pittsfield, about three-quarters of a mile northwest of the well known station at Adams Pond. On each occasion we had a different guide who was not aware of the other's interest in the plant. Both moreover were familiar with the plants at Adams Pond and both led us to the same locality — an area of recently cut-over woods covered with slash. The removal of protecting trees and the piling up of slash, the two most obvious disturbances from lumbering operations have caused the complete destruction of this rhododendron colony.

Manchester, New Hampshire colonies. — Most extraordinary changes have occurred to two stands of rhododendron in Manchester. We are indebted to Dr. Maurice Provost, now of Vero Beach, Florida, for the description of a colony which he discovered along Millstone brook. From his journal-account written at the time of his discovery on April 26, 1935, we quote the following, "all along the brook, for near-

ly one-quarter mile it formed a dense thicket which in places rose to almost 20 feet above the boggy ground." By following his directions which were most explicitly given in the journal, the senior author, on September 26, 1955, found the locality with little trouble. But the stand had shrunk in the interim to a few scattered meagre patches none over 7 or 8 feet in height. The area where the plants once grew so luxuriantly is now drier and more densely wooded than it was in 1935. These trees in 1955 were young, the indication being that there has been a drastic change in the associated forest since 1935.

Two reports from the last century allude to the presence in Manchester of a very large area occupied by rhododendrons. Wm. E. Moore in 1897[6] made the following comment, "About 2 miles northwest of Amoskeag Falls, lying to the east of and near the Valley of Black Brook is a great thicket covering from 60-80 acres and known as Rhododendron or Cedar Swamp." This without question is the place that Frederick W. Batchelder wrote about in 1899[7] as follows: "A high, wet swamp, difficult of access, near the northwest corner of Manchester, has long been known as a station of the beautiful 'rosebay'. The plants are usually in flower about July 4th. The swamp having recently been denuded of its trees the rhododendrons have not flowered as well as formerly, and after very cold winters the buds are mostly blighted."

On April 20, 1954 we visited the remnant of this stand guided by Mr. James Proctor, who lived nearby. The rhododendrons now are nearly confined to the swamp-border where the plants cover not more than 2 acres. Only occasional and very scattered plants could be seen in the swamp itself. The forest has developed very slowly during the approximately 60 years since the swamp was cleared. The occurrence of scattered rhododendrons in the swamp in 1955 indicates that with the improvement of conditions it again may become filled with the shrub.

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[6] Moore, Wm. E. Contributions to the History of Derryfield, 35, 1897.

[7] Batchelder, F. W. Preliminary list of plants in the vicinity of Manchester, New Hampshire in Proceedings of Manchester Institute of Arts and Sciences 1: pp. 110-111, 1899.

Hopkinton Colony. — We visited this small stand on June 2, 1959. The owner Frank Kimball, told us at that time that the plants had diminished greatly after the protecting forest trees had been cut off about 65 years before. With regrowth of suitable species including *Tsuga canadensis*, *Betula lutea*, *Fagus grandifolia* and *Acer rubrum* in the immediate vicinity this colony has regained its earlier size. The colony is not now reproducing by seedlings perhaps because the plants have so recently reached maturity and also possibly because the composition of the forest adjacent to the stand is not yet favorable for the growth of seedlings.

Richmond rhododendrons. — This colony, one of the earliest known in New Hampshire, had not been observed except by local residents for many years until it was rediscovered by Mr. Tudor Richards, the County Forester of Cheshire and Sullivan Counties. On May 19, 1956 we visited this stand which now consists only of scattered clumps growing over about 1½ acres of swampy forest land. Mr. M. Martin Fay the present owner told us that the rhododendrons originally covered about 7-8 acres, the growth being very luxuriant about 65 years ago, at which time the area was cut over without any concern for the rosebay. The rhododendrons as a result almost entirely disappeared. Presumably this explains why the Richmond colony that once was as well known as the famous stand in Fitzwilliam, became quite forgotten.

It is unfortunate that *R. maximum* is so sensitive to any marked disturbance of the forest trees with which it is commonly associated. Its effective conservation obviously depends on maintaining a mixed forest of mature or fairly mature trees to permit (1) some protection of larger rhododendron plants from excessive sunlight as well as over shading, (2) to provide suitable edaphic conditions throughout the year and (3) to make conditions right for seed germination and seedling growth.

It is reassuring that some colonies, like that in Sanford, Maine, have held their own or even improved in recent years. It is perhaps significant that many of our colonies are so situated that when conditions become intolerable in the swamp the plants can still survive on the better drained

swamp-border, the converse also being true when the conditions are reversed.

There is also some possibility that colonies of *R. maximum* may spread and then contract in a natural way in response to such factors as aging of the individuals that make up a stand or perhaps in response to climatic changes. —

DEPARTMENT OF BOTANY AND DEPARTMENT OF HORTICULTURE, UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NEW HAMPSHIRE.

NEW AND INTERESTING VASCULAR PLANT RECORDS FROM KANSAS

RONALD L. MCGREGOR

Intensive field studies in Kansas have resulted in the finding of eight species previously unreported for the State and new collection records for nine of the rarer species. Specimens are on file in the Herbarium, The University of Kansas.

SPECIES NEW TO KANSAS

Hilaria jamesii (Torr.) Benth. This species is not recorded for Kansas in any manual or State list. It may now be listed for southwestern Kansas with data as follows: Common on sandy soil in the Cimarron River valley, 8 miles north of Elkhart, Morton County, July 9, 1958, *McGregor 13981*.

Eleocharis atropurpurea (Retz.) J. & C. Presl. Found in large quantities on the margin of shallow ponds in the sand dunes north of Burrton, Harvey County, June 25, 1959, *McGregor 14531*. The species was associated with strand plants of *Marsilea mucronata* A. Br.

Holosteum umbellatum L. This naturalized species has become somewhat frequent in central and southcentral Kansas. It is now known from Mitchell, Rice, Reno, Kingman, Pratt, and Barber counties where it is found, during April, on sandy soils of lawns, fields, and roadside banks. Specific data on a representative collection is as follows: one mile east of Kingman, Kingman County, sandy field, April 26, 1959, *McGregor 14204*.

Chorispora tenella (Willd.) D C. The first record of this adventive species was a fragmentary specimen sent to me from Rice County in 1947. It has since been found in Chautauqua, Butler, Harvey, Riley and Rice counties. It has been found only in lawns, near feed lots and roadside banks. A representative collection is as follows: roadside bank, ½ mile south of Lyons, Rice County, April 24, 1959, *McGregor 14173*.

Vicia ludoviciana Nutt. Frequent on red gypsum soil prairies, seven miles west of Medicine Lodge, Barber County, May 28, 1957, *McGregor, 12863*. Plants occur as scattered individuals on prairie hillsides and in ravines.

Vicia dasycarpa Ten. This naturalized species is another Kansas record from the small Ozarkian area in the extreme southeastern corner of the state. The data are as follows: rocky hillside, four miles east of Baxter Springs, Cherokee County, June 9, 1957, *E. W. Lathrop 3737.*

Ammoselinum popei T. & G. This species has been reported from Kansas on the basis of a specimen in NY bearing the notation of "southwestern Kansas". It is now known from Kansas as follows: dry gypsum flats, seven miles south of Lake City, Barber County, May 9, 1959, *McGregor 14251.*

Mimulus glabratus H. B. K., var. **oklahomensis** Fassett. On sandy flat of small clear stream at Elm Mills, Barber County, April 24, 1959, *McGregor 14174.* At a similar location just one mile west was collected *Mimulus glabratus* H. B. K., var. *fremontii* (Benth.) Grant. This is the variety of the species found over most of western Kansas.

INFREQUENTLY COLLECTED PLANTS

Danthonia spicata (L.) Beauv. Previously reported only from the extreme southeastern corner of Kansas the species has been found to be common in the Chautauqua Hills area some ninety miles westward. Data is as follows: Open areas in scrub-oak hillsides, sandy soil, five miles east of Toronto, Woodson County, June 5, 1955, *Lathrop 636.*

Gymnopogon ambiguus (Michx.) B. S. P. Included in the Kansas flora on the basis of an old specimen from Chautauqua County with uncertain data. A recent collection is as follows: Ravine, sandstone canyon, three miles northeast of Sedan, Chautauqua County, August 19, 1959, *McGregor 15048.* The species was abundant in local areas.

Panicum perlongum Scribn. Formerly known from three counties in central part of the state the species is now known from east-central Kansas as follows: Common in rocky, big bluestem prairie, two miles northeast of Welda, Anderson County, June 8, 1956, *McGregor 12319.*

Juncus scirpoides Lam. Has been known only from the salt marsh area in Stafford County. The species is rather frequent on salty flats in the Medicine River valley of Barber County. A representative collection is as follows: Salt flat along Medicine River, eight miles south of Medicine Lodge, July 11, 1958, *McGregor 14070.*

Spiranthes gracilis (Bigel.) Beck. This species has been listed for Kansas from Cloud County. The specimen, however, is *S. lucida* (H. H. Eat.) Ames. Recent collections of *S. gracilis* have been made by the author from Bourbon, Chautauqua, Cherokee, Douglas, Franklin, Neosho and Woodson counties.

Salicornia rubra A. Nels. This species has been known in the state on the basis of an old collection made in Stafford County. It has been rediscovered with data as follows: barren salt plain, Great Salt Marsh, Stafford County, September 2, 1959, *McGregor 15193.* A few hundred plants were found in a localized area in the marsh and were associated with *Sesuvium verrucosum* Raf. and *Suaeda depressa* (Pursh) S. Wats.

Sesuvium verrucosum Raf. This species has been included in the

States flora on the basis of an old collection from Ford County. It has been found to be frequent on saline areas in Barber, Rice and Stafford Counties. A representative collection is: Common on saline plain, 1½ miles southeast of Hazelton, Barber County, July 28, 1959, *McGregor 14589*.

Mimosa borealis Gray. Known previously in Kansas only from Meade County it has now been located 85 miles east as follows: Gypsum Hills prairie, rocky hillside, five miles south and two miles east of Lake City, Barber County, June 24, 1959, *McGregor 14479*. Sixty-three of these shrubby plants were counted in the area.

Dalea compacta Spreng. From sand hill prairies, valley of Cimarron River, eight miles north of Elkhart, Morton County, July 9, 1958, *McGregor 13971*. Known previously only from Grant and Stevens counties. Some specimens from the Morton County colony had spikes 25 cm. long as compared with the usual descriptions of up to 15 cm. in length. — DEPT. OF BOTANY, UNIVERSITY OF KANSAS, LAWRENCE.

ELEOCHARIS ACICULARIS IN ACID MINE DRAINAGE

ELWOOD B. EHRLE

During a recent floristic study (Ehrle, 1958) the paucity of aquatic vegetation was noted as a characteristic of the flora of the eastern edge of the Allegheny Plateau in Central Pennsylvania. The waters of this area pass over and through strip mines and naturally exposed coal seams in their course to the streams forming the major pattern in the drainage basin of the West Branch of the Susquehanna River.

Leighton (1904) gave the following general description of streams polluted by acid mine drainage: "The appearance of a small stream into which coal-mine waters are discharged is peculiar. The bottom of the channel is colored a light yellow and there appear no signs of vegetation of any kind. All fish life in the stream is immediately destroyed at the first appearance of coal mine wastes." This description is incomplete only in omitting mention of the abundant mats of *Eleocharis acicularis* (L.) R. & S. in the more shallow portions of many such streams.

The records obtained by Love (1954) from the West Branch of the Susquehanna River, two miles downstream from Lock Haven (Clinton County, Pa.), are instructive in

demonstrating the pH conditions that prevail in the drainage basin under consideration. In 36 samples collected from this location between October, 1945 and September, 1950, the pH ranged from a low of 3.05 to a high of 4.6. Unpublished records of the Pennsylvania Fish Commission (Table I) illustrate the frequency of acid mine drainage and its effect on stream acidity.

Table I. The recorded pH of some of the streams of Clearfield County, Pa. Streams polluted with acid mine drainage are designated by the letters AMD following the pH value.

Stream	Tributary of	Date	pH
Mountain Run	Bennett's Branch	2- 5-58	5.0 AMD
Little Clearfield Creek	Clearfield Creek	3-21-56	7.2
Trout Run	W. Br. Susquehanna R.	3-21-56	6.8
Montgomery Run	Anderson Creek	5-17-56	4.4
W. Br. Susquehanna River	Susquehanna River	4-18-57	4.8 AMD
Sinnemahoning Cr. Bennett's Br.	Sinnemahoning Cr.	7-23-47	3.2 AMD
Cush Cushion Cr.	W. Br. Susquehanna R.	7-28-48	7.9
Deer Run	W. Br. Susquehanna R.	7-29-47	4.2 AMD
Horn Shanty Run	W. Br. Susquehanna R.	9- 5-51	6.3
LaBorde Run	Sandy Lick Creek	3- 5-57	4.6 AMD
Montgomery Cr.	W. Br. Susquehanna R.	9- 5-51	5.2 AMD
Little Muddy Cr.	Muddy Creek	7-25-47	3.0 AMD
Pine Creek	Clearfield Creek	9-25-56	5.8 AMD
Shryock Run	W. Br. Susquehanna R.	7-22-48	4.5 AMD

The data presented and the drainage conditions discussed in this paper account for: (1) the observation of a yellowish residue on rocks in many of the stream channels of the area, and (2) the rarity of aquatic vegetation. Only one aquatic species, *E. acicularis*, has been found to be present in most of these streams. It appears to thrive forming large, bright green, usually vegetative mats. In some cases the mats are extensive enough to form a semi-continuous cover over the stream bottom.

Other aquatics have not become established in the acid mine drainage of this area. The success of *E. acicularis* in such a situation is not alluded to in the habitat description "muddy shores" of Gleason (1952) or "damp shores and low grounds" of Fernald (1950). *E. acicularis* does occur in

damp to wet places as a semi-aquatic, but it also occurs as a true aquatic under the conditions described. —STATE UNIVERSITY COLLEGE OF EDUCATION AT GENESEO, N. Y.

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UNPUBLISHED RECORDS — Pennsylvania Fish Commission, Bellefonte Office. By Permission.

REVISION OF HETEROTHECA, SECTION HETEROTHECA (COMPOSITAE)

BURDETTE L. WAGENKNECHT

(Concluded)

DISTRIBUTION AND HABITATS: Northwestern Arizona to Sonora and Chihuahua, Mexico and Great Bend National Park, Texas. Sandy soil along small occasional streams, roadside ditches, waste places, in valleys at altitudes of 1,000 to 4,500 feet.

This species is most closely related to *Heterotheca latifolia* Buckl., from which it differs in the more robust habit, the elongate peduncles and the more glandular phyllaries. Specimens placed in this species have at various times been identified as *H. inuloides*, *H. leptoglossa*, *H. grandiflora* and *H. subaxillaris* (sensu *H. latifolia*).

The specific epithet refers to the habitat preference of this species. Apparently undisturbed silt and gravel soils are not colonized by it.

Representative specimens. **Texas:** Brewster Co.: Santa Helena Canyon, Big Bend National Park, *Moore and Steyermark 3467* (GH, PH, UC). **Arizona:** Cochise Co.: 8 mi. e. Pearce, *Wagenknecht 4880* (KANU); Graham Co.: 16 mi. s. Safford, *Gould & Haskell 3984* (CU); Pima Co.: 8 mi. n. w. Tucson, *Wagenknecht 4849* (KANU); Pinal Co.: 3 mi. n. w. Coolidge, *Wiggins & Rollins 481* (NY); Yavapai Co.: 10 mi. s. Prescott, *Gillespie 8532* (GH, UC). MEXICO: **Chihuahua:** Chihuahua, *Pringle 674* (GH, NY, PH, US), Camargo, *White 2289* (GH).

7. **H. latifolia** Buckley, Proc. Acad. Nat. Sci. Phila. **13**: 459. 1862

Annual or biennial aromatic herbs 0.5-2 m. (spring form 10-50 cm.) tall, the branching limited to the upper one-third to one-half of stem. Stem striate, velutinous, the velutinous indumentum becoming progressively dense below with spreading hairs up to 4.2 mm. long. Leaves alternate, ovate to elliptical or lanceolate, entire, dentate or serrate, sparsely pilose above, pilose below, the veins prominently raised. Lower leaves 1-7 cm. long, 0.5-4 cm. wide, petiolate (spring form with basal and cauline leaves prominently so), the petioles 1-2.5 cm. long with enlarged auriculate-clasping bases. Cauline leaves 0.3-2.4 cm. wide, 1-3 cm. long, becoming progressively smaller upward, sessile or partly clasping, sparsely toothed to entire. Inflorescence a loosely spreading or divaricate corymbose panicle; terminal involucres 0.8-1.8 cm. (spring form 0.4-0.9 cm.) wide, 4-8 mm. high, campanulate to hemispherical. Phyllaries in 4-6 series, the tips villous, the inner series 4-9 mm. long, glabrous on both surfaces, the margins scarious, the outer series 0.7-2.5 mm. long, sparsely strigose on outer surface and with sessile to capitate glands. Ray flowers 15-35, (spring form 6-25), the corolla tube 2-4 mm. long, the ligules 3-5 mm. long; disk flowers 25-40 (spring form 6-25), the tube 2-3 mm. long. Ray achenes 1.5-3.0 mm. long, trigonous, epappose, glabrous or bearing a few silky hairs on the angles. Disk achenes 2.2-3.2 mm. long, obovate, compressed, densely sericeous. Pappus of two series, the inner series of numerous barbellate bristles, 3.4-6.2 mm. long, reddish brown to white, the outer series squamellate-setaceous or of short barbellate bristles 0.3-0.6 mm. long. Receptacle flat, white, alvelolate, the partitions irregularly terminated by unequal chartaceous points.

Heterotheca latifolia was described by Buckley (1861). Gray (1862) after examining the type specimen dismissed the species with the statement, "*Heterotheca latifolia* is *Heterotheca chrysopsidis*." It is interesting that both Buckley's description and Gray's statement were ignored thereafter by authors dealing with this species in various floristic studies. Authors who dealt with this species usually identified it as *H. lamarckii* Cass. as distinguished from the scabrous *H. scabra* (Pursh) DC., which is found along the coasts. Britton and Rusby's transfer of Lamarck's species name to *Heterotheca* was presented in a paper which dealt with a specimen of *H. latifolia* Buckl. and had the result of linking the name *H. subaxillaris* (Lam.) Britton & Rusby to both species. As a result, *H. latifolia* was regarded by all authors as conspecific with *H. subaxillaris*.

The first person to express doubt as to the validity of the above treatment was Harper (1944). He said of *Heterotheca subaxillaris* as delimited at that time, "A variable species,

perhaps divisible into more than one. A prostrate form seems to be native on drifting sands on Dauphin Island, and Dr. Mohr reported it also from similar places in Baldwin County. Taller forms are occasionally seen in sandy waste places in the coastal plain and in recent years one has been quite abundant in and around railroad yards in Birmingham." An examination of his collections reveals that the prostrate form was *H. subaxillaris* var. *procumbens* and the taller forms were *H. latifolia* var. *latifolia*.

Shinners (1951) examined the type specimen of *Heterotheca latifolia* in the Herbarium of the Academy of Natural Sciences in Philadelphia and found it to be identical with the common old-field or waste-ground weed of central and eastern Texas.

Keever (1955), studying succession in abandoned fields of the southeastern states, found that *Erigeron canadensis* L. [*Conyza canadensis* (L.) Conq.], a first-year dominant, was being replaced by a species of *Heterotheca* which was unknown to her. Miss Keever was familiar with *H. subaxillaris* of the coastal areas and was not satisfied with an identification which placed her specimens in this species. Material sent to Dr. Shinners was identified as *H. latifolia*. Keever's investigation established the years 1945-46 as the approximate date of introduction of this species to the Piedmont of Georgia and the Carolinas. The source of these colonies is not given. No positive means of invasion has been definitely established, although the number of labels citing railroad yards as habitats in Mississippi and Alabama would indicate one possible avenue.

The earliest collection of *Heterotheca latifolia* made in Delaware was by Canby (1887). This plant has been misidentified as *H. subaxillaris*. An examination of cited specimens shows that both species occur in Delaware. Tatnall's (1946) comments on *H. subaxillaris* are of interest. The habitat description, "Common weed in dry pastures and on roadsides" could apply to either species in this locality, while a further statement, "An introduction from the southern states, spreading rapidly northward," appears to fit more closely the behavior pattern of *H. latifolia*. An ex-

amination of *Tatnall 4902*, identified as *H. subaxillaris*, shows it to be *H. latifolia*. Uttal (1954) reported *H. subaxillaris* on Long Island, but an examination of this specimen shows it to be *H. latifolia*. Uttal postulated the source of the colony as a weed in grass and sod brought to the area from Delaware. From the presence of the species in Delaware as indicated above, one would tend to agree with this theory.

Of interest is the recent invasion of Illinois by this species. Collections from Missouri include the following: *Eggert*, Pine Bluff (1896), *Bush*, Randolf (1927), and *Steyermark*, several collections in southern and eastern Missouri during the middle 1940's. During this period no collections were reported from Illinois, Dobbs (1946) reported the first Illinois collection as follows: "Another plant of very recent introduction in Illinois is *Heterotheca subaxillaris* (Lam.) Britt. & Rusby. This species much resembles *Chrysopsis villosa* (Pursh) Nutt., a psammophilous plant of rather frequent occurrence in Henry County, but may be distinguished from it by the achenes of the ray and disk flowers which are quite dissimilar. It is nearly ubiquitous in the southern states and Mexico, and is spreadng northward. On September 17, 1944, a few plants were found along railroad tracks near the village of Green River, and they were still persisting at the time of my last revisit which was on September 9, 1945. Although this region has been botanized rather frequently, no specimens were seen prior to the above dates. Deam does not report it for Indiana, and the writer has not heard of its occurrence elsewhere in Illinois. More time will be needed to determine its exact status in Illinois." Dobbs (1952) is a report of the same record. Bailey (1949) did not include the species in his report. Jones and Fuller (1955) reported, in addition to the Henry County station, a collection from Union County, the latter falling within the area covered by Bailey's paper. Private correspondence with Professor R. H. Mohlenbrock, Southern Illinois University, Carbondale, reveals that a collection was made in Pulaski County, *Mohlenbrock & Voigt 5896*, on June 22, 1955. The specimen was not seen. The well-recorded in-

vasion shows the ability of this species to speedily occupy a new area.

At the southern limits of its range, occasional plants of the species are able to survive mild winters and flower again during the spring and early summer. The appearance of these individuals is quite different from the so-called normal plants which flower in the fall. The earlier the plant flowers, the more it differs from the fall-flowering members of the species. With experience one can estimate fairly accurately the season of collection of a specimen of *Heterotheca latifolia*, even without consulting the collection data. The spring forms are much shorter than the fall ones and become, in extreme cases, rosette forms with a short branching inflorescence; the flowers are smaller and may bear as few as six ray flowers and six disk flowers; all leaves below the inflorescence are characteristically petiolate and the petioles are dilated not at all or only slightly at the base. Benke (1928) described *H. subaxillaris* var. *petiolaris* from a specimen (*Benke 4585* F) which he collected on March 12, 1928. This specimen was not studied, but others, cited as being "exactly of the same description", *Hall 312*, March 16, 1872, and *Hays 399*, Belknap, Texas, March 30, 1858, were seen. It is interesting to note that with regard to the time of year, these plants were collected within an eighteen day period. Two specimens, "which though somewhat similar do not quite agree with type" are *Dixon 71*, Huntsville, Texas, June 3-12, and *Dixon 217*, Riverside, Texas, June 19. These specimens approach more nearly the fall form. Since this variation is due to the time of year in which the plant is collected, var. *petiolaris* is considered here to be a synonym of *H. latifolia* var. *latifolia*.

7a. **H. latifolia** var. **latifolia**

Heterotheca subaxillaris (Lam.) Britt. & Rusby var. *petiolaris* Benke. Rhodora **30**: 201. 1928.

TIME OF FLOWERING: July to November in Oklahoma, northern Texas, New Jersey and Georgia; March-December in southern parts of range.

TYPE AND TYPE LOCALITY: *Buckley*, Llano County, Texas. (PH).

DISTRIBUTION AND HABITATS: native to Louisiana, Oklahoma, Texas and northern Mexico, introduced from New Jersey south to Georgia west to Alabama. Sandy or disturbed soils in open woods, roadsides, fields, waste ground and along railroads.

Representative specimens. **New Jersey:** Cape May Co.: *Brown* (GH). **Delaware:** Kent Co.: 1 mi. s. Choptank Mills, *Tatnall 4902* (PH). **Maryland:** Talbot Co.: 1 mi. s. w. Easton, *Earle 3715* (PH). **Virginia:** Princess Anne Co.: Cape Henry, *Egler 40-245* (NY). **North Carolina:** Rutherford Co.: 3 mi. e. Forest City, *Channell 2679* (SMU). **South Carolina:** Cherokee Co.: 3 mi. s. w. Gaffney, *Keever* (NY); Edgefield Co.: Clark Hill Dam, *Duncan 9982* (SMU); Marion Co.: bank of Great Pee Dee River, *Leeds 1902* (PH); Spartanburg Co.: 5 mi. w. Chesne, *Fox 5252* (SMU). **Georgia:** Columbia Co.: *Duncan 11779* (CU, OKLA, SMU); Houston Co.: Welston, *Ainsworth 44912.5* (PH). **Alabama:** Elmore Co.: *Justice 243* (CU). Greene Co.: 1.3 mi. n. e. Epes, *Shinners 12717* (SMU); Jefferson Co.: Montgomery, *Harper 3433* (GH, NY, PH, US); Sumter Co.: Sumterville, *Whitehouse 24389* (SMU). **Mississippi:** Adams Co.: *Smith 583* (US); Jefferson Co.: *McDougall 1118* (US). **Missouri:** Stoddard Co.: 3.5 mi. s. w. Pyletown, *Steyermark 66190* (F). **Arkansas:** Columbia Co.: Magnolia, *Demaree 21779* (NY, UC); Desha Co.: Arkansas City, *Demaree 27275* (SMU, TEX); Hempstead Co.: *Moore & Lee 29* (TEX); Pulaski Co.: Arkansas River, *Demaree 8631* (GH, US). **Louisiana:** Allen Parish: Oakdale, *Shinners 22081* (SMU); Bossier Parish: 11.4 mi. e. n. e. Bossier City, *Shinners 21746* (SMU); Caddo Parish: Fort Humug, *Correll & Correll 10087* (GH, NY); Claiborne Parish: 1.4 mi. s. e. Gordon, *Shinners 24560* (SMU); Natchitoches Parish: 2.2 mi. s. s. e. Natchitoches, *Shinners 20007* (SMU); Rapides Parish: *Hale* (F). **Kansas:** Wyandotte Co.: Kansas City, *MacKenzie* (F). **Oklahoma:** Cleveland Co.: 10 mi. e. Norman, *Nelson, Nelson, & Hopkins 781* (UC); Love Co.: 16 mi. e. Marietta, *Shinners 12905* (SMU); McCurtain Co.: 1 mi. s. Torn, *Waterfall 10467* (SMU); Marshall Co.: 0.5 mi. w. Uobs, *Riggs* (SMU); Mays Co.: *Stevens 2583* (GH, NY, US); Murray Co.: Platt. Nat. Park, *Merrill & Hagan 1271* (F, NY); Oklahoma Co.: Oklahoma City, *White 1141* (GH, SMU). **Texas:** Anderson Co.: 3.7 mi. n. Montalba, *Cory 53905* (SMU); Angelina Co.: Lufkin, *Rhoades 55* (CU); Arkansas Co.: Rockport, *Cory 51221* (SMU); Bandera Co.: 10.3 mi. w. n. w. Bandera, *Shinners 16881* (SMU); Bell Co.: 4 mi. w. Belton, *York & York 53050* (SMU); Bexar Co.: Bandera Road, *Schultz* 314 (US); Brazos Co.: 3.7 mi. e. Kurten, *Cory 50621* (SMU); Brooks Co.: King Ranch, Encino Division Headquarters, *Gould & Morrow 6760* (SMU); Burnet Co.: 8 mi. w. Burnet, *Turner & Johnson 2477* (TEX); Camp Co.: 1.7 mi. s. w. Newcome, *Shinners 16275* (SMU); Colorado Co.: 5 mi. n. e. Columbus, *Shinners 14614* (SMU); Comal Co.: Comanche Springs, New Braunfels, etc., *Lindheimer 926* (F, GH, MEX, NY, PH, TEX, UC, US); Dallas Co.: Dallas, *Barr 23* (SMU); Denton Co.: Lake Dallas Dam, *McCart 604* (SMU, TEX); Donley Co.: Hedley, *Martin 2901* (US); Fayette Co.: Muldoon, *Ripple 51-728* (TEX); Floyd Co.: Plainview, *Ferris & Cundan 3370* (NY); Freestone Co.: 13 mi. s. Fairfield, *Shinners 12941* (SMU); Galveston Co.: Texas City, *Turner 1733* (SMU); Goliad Co.: Goliad, *Williams 85* (PH); Gregg Co.: Longview, *Shinners 16227* (SMU); Grimes Co.: Plantersville, *Stoneham* (US); Guadalupe Co.: Sequin, *Groth 197* (CU, F, GH, US); Harris Co.:

Houston, *Anderson 36-4* (TEX); Harrison Co.: 11 mi. s. w. Marshall, *Steyermark 52293* (F); Henderson Co.: 2.5 mi. s. e. Eustace, *Shinners 9592* (SMU); Hidalgo Co.: 7 mi. w. Mission, *Uzzell 25* (TEX); Hill Co.: 3.6 mi. s. w. Hinton, *Shinners 12069* (SMU); Hood Co.: 5.5 mi. n. e. Granbury, *Shinners 10332* (SMU); Hopkins Co.: Picton, *Whitehouse 17569* (SMU); Hutchinson Co.: 3 mi. n. Stinnett, *Cory 50326* (SMU); Jackson Co.: 3 mi. s. Vanderbilt, *Tharp & Barkley 13A159* (F, PH, TEX); Jasper Co.: 2.5 mi. s. Jasper, *Shinners 25138* (SMU); Johnson Co.: Cleburne State Park, *Cory 58000* (SMU); Karnes Co.: 2 mi. s. Karnes City, *Johnson 1009* (SMU, TEX); Kaufman Co.: Terrell, *Shinners 10838* (SMU); Kenedy Co.: 3.4 mi. s. Armstrong, *Shinners 17093* (SMU); Knox Co.: 1 mi. n. Goree, *Sumanth 266* (SMU); La Salle Co.: 10.2 mi. n. w. Cotulla, *Shinners 17301* (SMU); Leon Co.: 23 mi. s. w. Buffalo, *Shinners 7138* (SMU); Liberty Co.: 2.8 mi. s. w. Cleveland, *Shinners 25306* (SMU); Limestone Co.: Tehuacana, *Miles* (SMU); Live Oak Co.: 7 mi. w. Three Rivers, *Shinners 16984* (SMU); Llano Co.: *Whitehouse* (TEX); Lubbock Co.: Lubbock, *Reed 3942* (CU, TEX, US); McLennan Co.: Gaphead Road, *Smith 76* (TEX); Montague Co.: 1.3 mi. w. Barnie, *Storm 1123* (SMU); Montgomery Co.: 3 mi. n. w. Conroe, *Shinners 16538* (SMU); Nacogdoches Co.: 4.7 mi. e. Douglas, *Shinners 24883* (SMU); Palo Pinto Co.: 6 mi. w. Palo Pinto, *Anderson & Harty 25* (SMU); Panola Co.: 9 mi. s. Carthage, *Shinners 6703* (SMU); Parker Co.: 1.4 mi. s. s. w. Springtown, *Shinners 16420* (SMU); Presidio Co.: 8 mi. e. Presidio, *Hinckley 1303* (NY, SMU); Red River Co.: 16.2 mi. n. Clarksville, *Whitehouse 20573* (SMU); Robertson Co.: 7 mi. n. e. Hearne, *Shinners 7144* (SMU); San Patricio Co.: 7.5 mi. w. Taft, *Jones 420* (OKLA, SMU); San Saba Co.: 3 mi. s. e. San Saba, *Cory 58285* (SMU); Smith Co.: 1 mi. e. Troup, *Cory 55576* (SMU); Titus Co.: Talco School, *Cato 6481* (TEX); Travis Co.: Austin, *Waldorf* (NY, TEX, UC); Val Verde Co.: Del Rio, *Warnock 853* (CU, TEX); Van Zandt Co.: Willa Point, *Stewart 165* (SMU); Walker Co.: Huntsville, *Whitehouse 6649* (TEX); Waller Co.: Hempstead, *Lundell & Lundell 11019* (SMU); Wise Co.: 12.7 mi. w. Rhome, *Whitehouse 19221* (SMU); Young Co.: 3 mi. s. w. Newcastle, *Woolfolk 8* (SMU). **New Mexico:** Quay Co.: Nara Visa, *Fisher 49* (US). **Arizona:** Cochise Co.: *Shinners 17392* (SMU); Maricopa Co.: Salt River, *Butler 48* (TEX); Pima Co.: Tucson, *Wiggins 6228* (US). MEXICO: **Nuevo León:** Monterry, *Kenoyer 1094* (SMU). **Coahuila:** Saltillo, *Fisher 4* (F). **Sonora:** Hermosillo, *Rose, Standley & Russell 12497* (NY, US). Sinaloa: Fuerte, *Rose, Standley & Russell 13437* (US). BRAZIL: **Rio Grand de Sul:** Porto Alegre, *Renick* (GH).

7b. **H. latifolia** var. **macgregoris** var. nov.

Folia oblongo-lanceolata, remote serrata, in ambitu pilosa. Involucra plus quam 0.9 cm. lata.

Leaves oblong-lanceolate, remotely serrate, upper and lower leaf surfaces pilose. Involucres more than 0.9 cm. in width.

TIME OF FLOWERING: July to October.

TYPE AND TYPE LOCALITY: *R. L. McGregor 5163*, dry sandy prairie,

Morton County, Kansas. Deposited in the Herbarium of the University of Kansas (KANU).

DISTRIBUTION AND HABITATS: Kansas, Oklahoma, northern Texas, southeastern Colorado, New Mexico, and Arizona; introduced to New York; New Jersey and Delaware. Sandy soils along streams, in prairies, overgrazed pastures and roadsides, at altitudes of 800 to 1,500 feet.

It gives me great pleasure to name this variety in honor of Professor R. L. McGregor, whose counsel and guidance were of inestimable value in connection with the present study.

Representative specimens. **New York:** Suffolk Co.: La Guardia Field, *Uttal* (NY). **New Jersey:** Cumberland Co.: 1 mi. n. Leesburg, *Blake 11958* (GH, US). **Delaware:** Sussex Co.: Slaughter Beach, *Larsen 1080* (PH). **Illinois:** Henry Co.: Sect. 7, Edford Township, *Dobbs* (GH). **Kansas:** Barber Co.: 6 mi. n. Medicine Lodge, *Wagenknecht 4617* (KANU); Barton Co.: 6 mi. s. w. Great Bend, *Wagenknecht 4585* (KANU); Clark Co: 4 mi. w. Ashland, *Wagenknecht 4677* (KANU); Comanche Co.: 1 mi. s. Coldwater, *Wagenknecht 4640* (KANU); Douglas Co.: *McGregor 359* (KANU); Finney Co.: *Kellerman* (PH); Harper Co.: 2 mi. e. Harper, *McGregor 13752* (KANU); Kiowa Co.: 3 mi. w. Greenburgh, *McGregor 4040* (KANU); Meade Co.: Meade Co. State Park, *Horr 3686* (KANU); Morton Co.: 9 mi. n. Elkhart, *McGregor 5163* (KANU); Ottawa Co.: 3 mi. s. Minneapolis, *Horr E585* (KANU, OKLA, SMU, UC, US); Reno Co.: Medora sand dunes, *Gates 21911* (TEX, US); Rice Co.: 3 mi. e. Raymond, *Wagenknecht 4419* (KANU); Rooks Co.: Rockport, *Bartholomew* (NY); Saline Co.: Brookville, *Gates 20619* (F, NY, PH); Sedgwick Co.: near Wichita, *Branch 78* (CU); Seward Co.: 25 mi. s. w. Meade, *Fearing & Latham* (US); Stafford Co.: 8 mi. n. e. Hudson, *McGregor 13694* (KANU). **Oklahoma:** Beckham Co.: Red River, *Eskew 1515* (PH); Caddo Co.: 3 mi. w. Andarko, *Nelson, Nelson & Hopkins 894* (UC); Cleveland Co.: 4 mi. w. Norman, *Nelson, Nelson, & Hopkins 748* (OKLA, SMU); Comanche Co.: Fort Sill, *Clemens 11,810* (GH, NY); Custer Co.: Weatherford, *Waterfall 751* (GH, NY); Ellis Co.: 4.5 mi. s. Arnett, *Nelson, Nelson & Goodman 5335* (SMU, TEX); Kay Co.: *Keyser 6082* (NY); Pawnee Co.: Cleveland, *Palmer 6383* (CU, US); Payne Co.: 1 mi. s. Perkins, *Atkins 35* (SMU); Woods Co.: Alva, *Stevens 2841* (GH, US); Woodward Co.: *Lock 47* (US). **Texas:** Bailey Co.: Coyote Lake, *Ferris & Duncan 3441* (NY); Clay Co.: Henrietta, *Whitehouse 10832* (SMU); Coke Co.: *Cory 5303* (GH); Hardeman Co.: 7.2 mi. n. Quansh, *Whitehouse 10755* (SMU); Hemphill Co.: *Carleton 538* (F, NEB, US); Mitchell Co.: Colorado City, *Pohl 4300* (SMU); Taylor Co.: *Tolstead 7526* (SMU, TEX, UC); Ward Co.: *Pennell 19357* (PH); Wheeler Co.: 3.5 mi. n. Shamrock, *Cory 50244* (SMU); Winkler Co.: 2 mi. n. Winkler, *Warnock & Parks 8799* (SMU). **Colorado:** Baca Co.: Sandy flats, Cimarron River, *Weber 5165* (SMU). **New Mexico:** Eddy Co.: 5 mi. n. e. Carlsbad, *Albers 46292* (TEX); Chavez Co.: 7 mi. n. e. Boaz, *Waterfall 4322* (GH). **Arizona:** Pima Co.: Tucson, *Ginter*, (US).

7c. **H. latifolia** var. **arkansana** var. nov.

Folia ovata vel lanceolata, serrata, in ambitu pilosa, rami laterales divaricati.

Leaves ovate to lanceolate, coarsely serrate, upper and lower surfaces pilose. Lateral branches widely spreading.

TIME OF FLOWERING: July to November.

TYPE AND TYPE LOCALITY: *D. M. Moore 30142*, Magazine Mountain, Logan County, Arkansas. Deposited in the Herbarium of the University of Texas (TEX).

DISTRIBUTION AND HABITATS: Southern Missouri, Arkansas, eastern Oklahoma, eastern Texas, and introduced to Maryland. Sandy or rocky ground in pastures and along roadsides at altitudes of 600 to 2,000 feet.

Representative specimens. **Maryland:** Wicomico Co.: Quantico, *Tidestrom 7417* (US). **Missouri:** Butler Co.: Batesville, *Steyermark 74503* (F); St. Louis Co.: St. Louis, *Muhlenback 756* (F). **Arkansas:** Desha Co.: Fayetteville, *Moore 480643* (TEX); Jefferson Co.: Pine Bluff, *Demaree 16243* (F); Montgomery Co.: Caddo River bottoms, *Demaree 9585* (NY); Pike Co.: Little Missouri River bottoms, *Demaree 9678* (NY); Pulaski Co.: Little Rock, *Demaree 22362* (NY, UC). **Oklahoma:** Cherokee Co.: 6.7 mi. n. e. Tahlequah, *Wallis 5981* (SMU). **Texas:** Bowie Co.: Texarkana, *Heller & Heller 4092* (CU, F, GH, NEB, NY, PH, TEX, UC, US).

Excluded Species

Heterotheca deltoidea Klatt. Ann. K. K. Natur. Hoff. 9: 258. 1894.

An examination of a fragment of the type (F) and photographs of the type (F, US), prove this species to be a member of a genus not known to the author.

Heterotheca grievii Benson. Bot. Gaz. 74(2): 121. 1922.

This species is a microsporangiate organ genus attributed to *Heterangium grievii*, a paleobotanical genus of Lower Carboniferous Pteridosperm Stems, and not a member of the group under investigation.

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THIRTEENTH REPORT OF THE COMMITTEE ON PLANT DISTRIBUTION

The twelfth report included the Dicotyledoneae through Aizoaceae. The present report deals with the families from Portulaceae through Lauraceae, taken in the order of the eighth edition of Gray's manual.

The data for these reports have been compiled from the herbarium of the New England Botanical Club and the Gray Herbarium.

PRELIMINARY LISTS OF NEW ENGLAND PLANTS—XXXVIII

The sign + indicates that an herbarium specimen has been seen, the sign — that a reliable printed record has been found and the sign * is used for those plants which are not native in the New England area.

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
PORTULACACEAE						
Claytonia caroliniana Michx.	+	+	+	+		+
Claytonia virginica L.	—	—	—	+	+	+
Montia lamprosperma Cham.	+					
*Montia perfoliata (Donn) Howell		+				
*Montia sibirica (L.) Howell				+		
*Portulaca grandiflora Hook.			+	+	+	+
*Portulaca oleracea L.	+	+	+	+	+	+
CARYOPHYLLACEAE						
*Agrostemma Githago L.	+	+	+	+	+	+
Arenaria caroliniana Walt.					+	
Arenaria groenlandica (Retz.) Spreng.	+	+	+			
Arenaria groenlandica var. glabra (Michx.) Fern.	+	+		—	+	+
Arenaria lateriflora L.	+	+	+	+	+	+
Arenaria macrophylla Hook.			+	+		+
Arenaria peploides L. var. robusta Fern.	+	+		+	+	+
Arenaria rubella (Wahlenb.) Small			+			
*Arenaria serpyllifolia L.	+	+	+	+	+	+
*Arenaria serpyllifolia var. tenuior Mert. & Koch	+	+	+	+		+
Arenaria stricta Michx.		+	+	+		+
Cerastium arvense L.	+	+	+	+	—	+
Cerastium nutans Raf.			+	+		+
*Cerastium semidecandrum L.				+	+	+
*Cerastium viscosum L.			—	+	—	
*Cerastium vulgatum L.	+	+	+	+	+	+
*Cerastium vulgatum f. glandulosum (Boenn.) Druce				+		
*Dianthus Armeria L.	+	+	+	+	+	+
*Dianthus barbatus L.	+	+	+	+	+	+
*Dianthus deltoides L.	+	+	+	+		+
*Dianthus plumarius L.	+	+	+	+		—
*Gypsophila elegans Bieb.	+	+		+		+
*Gypsophila muralis L.	+	+	+	+	+	+
*Gypsophila paniculata L.	—		+			+
*Herniaria glabra L.	+					
*Holosteum umbellatum L.				+	+	+
*Lychnis alba Mill.	+	+	+	+	+	+
*Lychnis chalcedonica L.	+	+	+	+		+
*Lychnis coronaria (L.) Desr.	+	+	+	+	+	+

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
*Lychnis dioica L.	+	+	+	+	+	+
*Lychnis Flos-cuculi L.	+	+	+	+	+	+
*Lychnis Viscaria L.	+	+		+		+
*Myosoton aquaticum (L.) Moench		+	+	+		+
Paronychia argyrocoma (Michx.) Nutt. var. albimontana Fern.	+	+		+		
Paronychia canadensis (L.) Wood		+	+	+	+	+
Paronychia fastigiata (Raf.) Fern.				+	—	+
Sagina decumbens (Ell.) T. & G.			+	+		+
Sagina nodosa (L.) Fenzl	+					
Sagina nodosa var. pubescens Mert. & Koch	+			+		
Sagina procumbens L.	+	+	+	+	+	+
*Saponaria ocymoides L.				+		
*Saponaria officinalis L.	+	+	+	+	+	+
*Saponaria Vaccaria L.	+	+	+	+	+	+
*Scleranthus annuus L.	+	+		+	+	+
Silene acaulis L. var. exscapa (All.) DC	+	+				
Silene antirrhina L.	+	+	+	+	+	+
Silene antirrhina f. apetala Farw.	+	+		+	—	+
Silene antirrhina f. Deaneana Fern.	—			+	+	+
*Silene Armeria L.	+	+	+	+	+	+
Silene caroliniana Walt. var. pensylvanica (Michx.) Fern.		—		+	+	+
*Silene conica L.				+		
*Silene Cserei Baumg.	+	+	+	+	+	
*Silene Cucubalus Wibel	+	+	+	+	+	+
*Silene dichotoma Ehrh.	+	+	+	+		+
*Silene gallica L.	+	+	+			
*Silene nivea (Nutt.) Otth.	+					
*Silene noctiflora L.	+	+	+	+	+	+
*Silene nutans L.	+					
*Silene pendula L.	+					
Silene stellata (L.) Ait. f.			+	—	+	+
*Spergula arvensis L.	+	+	+	+	+	+
*Spergula arvensis var. sativa (Boenn.) Reichenb.			+			+
Spergularia canadensis (Pers.) Don	+	+		+	+	+
Spergularia marina (L.) Griseb.	+	+		+	+	+
Spergularia marina var. leiosperma (Kindb.) Gurke	+	+		+	+	+
*Spergularia rubra (L.) J. & C. Presl.	+	+	+	+	+	+
Stellaria Alsine Grimm	+	+	+	+		
Stellaria calycantha (Ledeb.) Bong.	+	+	+			+
Stellaria calycantha var. floribunda Fern.	+	+	+	+		+
Stellaria calycantha var. isophylla Fern.	+	+	+	+	+	+
*Stellaria graminea L.	+	+	+	+	+	+
*Stellaria Holostea L.				+		+
Stellaria humifusa Ehrh.	+					
Stellaria longifolia Muhl.	+	+	+	+	+	+
*Stellaria media (L.) Cyrillo.	+	+	+	+	+	+
Stellaria pubera Michx.			+			+
Stellaria pubera var. silvatica (Beguinot) Weath.						+
*Tunica Saxifraga (L.) Scop.			—	+		
CERATOPHYLLACEAE						
Ceratophyllum demersum L.	+	+	+	+	+	+
Ceratophyllum echinatum Gray	+		+	+	+	+
NYMPHAEACEAE						
Brasenia Schreberi Gmel.	+	+	+	+	+	+
*Cabomba caroliniana Gray		—		+		+
*Nelumbo lutea (Willd.) Pers.			—	+		+
Nuphar advena (Ait.) Ait. f.	+					—

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
Nuphar microphyllum (Pers.) Fern.	+	+	+	+		+
x Nuphar rubrodiscum Morong	+	+	+	+	+	—
Nuphar variegatum Engelm.	+	+	+	+	+	+
Nymphaea odorata Ait.	+	+	+	+	+	+
Nymphaea odorata var. gigantea Tricker				+	—	
Nymphaea odorata f. rubra Guillon	+	+		+		
Nymphaea tetragona Georgi	+					
Nymphaea tuberosa Paine			+			+
RANUNCULACEAE						
*Aconitum Napellus L.	+	+	+	+		—
Actaea pachypoda Ell.	+	+	+	+	+	+
Actaea pachypoda f. rubrocarpa (Killip) Fern.		+	—	+		
Actaea rubra (Ait..) Willd.	+	+	+	+	+	+
Actaea rubra f. neglecta (Gillman) Robins.	+	+	+	+		+
Anemone canadensis L.	+	+	+	+		+
Anemone cylindrica Gray	+	+	+	+	+	+
Anemone multifida Poir.	+		+			
*Anemone nemorosa Lam.				+		
Anemone quinquefolia L.	+	+	+	+	+	+
Anemone riparia Fern.	+	+	+	+	+	+
Anemone virginiana L.	+	+	+	+	+	+
Anemone virginiana f. leucosepala Fern.	+	+	+	+	+	+
Anemonella thalictroides (L.) Spach	+	+	+	+	+	+
Aquilegia canadensis L.	+	+	+	+	+	+
Aquilegia canadensis var. coccinea (Small) Munz		+				+
Aquilegia canadensis var. flaviflora (Tenney) Britt.				+		+
Aquilegia canadensis f. Phippenii (J. Robinson) H. Hoffm.	+			+		—
*Aquilegia vulgaris L.	+	+	+	+	+	+
Caltha palustris L.	+	+	+	+	+	+
Cimicifuga racemosa (L.) Nutt.	+	+	—	+		+
Cimicifuga racemosa f. dissecta (Gray) Fern.						+
*Clematis dioscoreifolia Levl. & Vaniot var. robusta (Carr.) Rehd.				+		+
Clematis verticillaris DC.	+	+	+	+	+	+
Clematis virginiana L.	+	+	+	+	+	+
Coptis groenlandica (Oeder) Fern.	+	+	+	+	+	+
*Delphinium Ajacis L.			—	+	+	+
*Delphinium consolida L.					+	—
Hepatica acutiloba DC.	+	+	+	+		+
Hepatica americana (DC.) Ker	+	+	+	+	+	+
Hydrastis canadensis L.			+			+
*Nigella damascena L.				+		+
Ranunculus abortivus L.	+	+	+	+	+	+
Ranunculus abortivus var. acrolasius Fern.	+	+	+	+	+	+
Ranunculus abortivus var. eucyclus Fern.	+	+	+	+		+
*Ranunculus acris L.	+	+	+	+	+	+
*Ranunculus acris var. latisectus G. Beck	+	+	+	+	+	+
Ranunculus allegheniensis Britt.		—	+	+	+	+
Ranunculus ambigens S. Wats.	+	+		+	+	+
*Ranunculus bulbosus L.	+	+	+	+	+	+
*Ranunculus bulbosus var. dissectus Babey	+			+	+	
*Ranunculus bulbosus var. valdepubens (Jord.) Briq.				+	+	
Ranunculus Cymbalaria Pursh	+	+		+	+	—
Ranunculus fascicularis Muhl.		+	—	+		+
*Ranunculus Ficaria L.				+		

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
Ranunculus flabellaris Raf.	+	+	+	+	+	+
Ranunculus flabellaris f. riparius Fern.	+		+	+		+
Ranunculus Gmelini DC. var. Hookeri (D.Don) Benson	+					
Ranunculus hispidus Michx.						+
Ranunculus hispidus var. falsus Fern.			+	+		+
Ranunculus lapponicus L.	+					
Ranunculus longirostris Godr.			+	+		+
Ranunculus micranthus Nutt. var. delitescens (Greene) Fern.				+	-	+
Ranunculus pensylvanicus L. f.	+	+	+	+	+	+
Ranunculus recurvatus Poir.	+	+	+	+	+	+
Ranunculus recurvatus f. laevicaulis Harger		+	—	+	+	—
*Ranunculus repens L.	+	+	+	+	+	+
*Ranunculus repens var. erectus DC.				+		
*Ranunculus repens var. glabratus DC.	+	+		+		+
*Ranunculus repens var. linearilobus DC.	+			+		
*Ranunculus repens var. pleniflorus Fern.	+	+	+	+		+
*Ranunculus repens var. villosus Lamotte	+	+		+	+	—
Ranunculus reptans L.	+	+	+	+		+
Ranunculus reptans var. ovalis (Bigel.) T. & G.	+	+	+	+	—	+
Ranunculus sceleratus L.	+	+	—	+	+	+
Ranunculus septentrionalis Poir.	+	+	+	+		+
Ranunculus subrigidus W. B. Drew			+	+		+
Ranunculus trichophyllus Chaix	+	+	+	+		+
Ranunculus trichophyllus var. calvescens W. B. Drew	+	+	+	+	+	+
Thalictrum confine Fern.	+		+			
Thalictrum dasycarpum Fisch. & Lall.				+	+	+
Thalictrum dioicum L.	+	+	+	+	+	+
Thalictrum polygamum Muhl.	+	+	+	+	+	+
Thalictrum polygamum var. hebecarpum Fern.	+	+	+	+		
Thalictrum polygamum var. intermedium Boivin					+	+
Thalictrum revolutum DC.				+	+	+
Trollius laxus Salisb.						+
*Xanthorhiza simplicissima Marsh.				+		
BERBERIDACEAE						
*Berberis Thunbergii DC.	+	+	—	+	—	+
*Berberis vulgaris L.	+	+	+	+	+	+
Caulophyllum thalictroides (L.) Michx.	+	+	+	+		+
Podophyllum peltatum L.	+		+	+		+
LARDIZABALACEAE						
*Akebia quinata Dene.				+		+
MENISPERMACEAE						
Menispermum canadense L.			+	+		+
MAGNOLIACEAE						
Liriodendron Tulipifera L.	—	+	+	+	+	+
*Magnolia acuminata L.	—			+		+
*Magnolia tripetala L.	—			+		+
Magnolia virginiana L.				+		
CALYCANTHACEAE						
*Calycanthus fertilis Walt.						+
LAURACEAE						
Lindera Benzoin (L.) Blume	+	+	+	+	+	+
Lindera Benzoin f. xanhocarpa (G. S. Torr.) Rehd.				+		
Sassafras albidum (Nutt.) Nees	+	+	+	+	+	+
Sassafras albidum var. molle (Raf.) Fern.	+	+	+	+	+	+

The Portulacaceae and the Caryophyllaceae were treated by B. L. Robinson in 1902 (Rhodora V-188 and 235) and the Ranunculaceae by C. A. Weatherby, C. H. Knowlton and W. S. Ripley Jr. in 1918 (Rhodora XX-182 and 193). In the years since these previous reports were published more specimens have come into the herbaria. Also there have appeared plant lists for three of the New England States: "The Flora of Vermont" in 1937, "Check-List of the Vascular Plants of Maine" in 1948 and "The Flora of Rhode Island" in 1952.

In general the introduced plants have tended to spread during the intervening years. The native species in many cases show the same distribution as in the earlier reports. Some of the exceptions are here listed.

Arenaria caroliniana, a coastal plain species previously unreported, has now been collected in Weekapaug and Westerly, Rhode Island. *Ranunculus lapponicus* was collected by G. D. Chamberlain in 1939 in Mapleton, Maine and was seen in other localities in the Aroostook River Basin, the first stations for this species in New England. *Actaea pachypoda* forma *rubrocarpa* and *Ranunculus abortivus* var. *acrolasius* were not recognized until after 1918.

Cerastium nutans, *Ranunculus longirostris* and *R. subrigidus*, formerly known from western Vermont and Connecticut, have now been collected in western Massachusetts. *Arenaria macrophylla*, reported from Vermont only, has now been found in Massachusetts and Connecticut.

Silene acaulis var. *exscapa* has been collected on Mt. Katahdin, Maine as well as in the White Mountains. *Silene stellata*, previously known from Rhode Island and Connecticut, is now represented by a specimen from Windsor, Vermont.

The geographical areas are the same as used in the previous reports. It is interesting to note that in spite of the large number of species and varieties represented, there are only four that can be considered as generally distributed. Here again a large number of the plants included are not native to New England but the percentage is not so great as in the previous report; only forty percent of the plants are introduced. Because of this the various subgroups in

this latter category are used as in the previous report.

I. GENERALLY DISTRIBUTED. — *Arenaria lateriflora, Nuphar variegatum, Clematis virginiana, Thalictrum polygamum.*

Ia. GENERAL, EXCEPT THE COAST OF WASHINGTON COUNTY, MAINE. — *Cerastium arvense, Ceratophyllum demersum, C. echinatum, Brasenia Schreberi, Nymphaea odorata, Actaea rubra, Anemone quinquefolia, Ranunculus recurvatus.*

Ceratophyllum echinatum is very local. There are only three widely scattered stations in Maine and none in Vermont or Rhode Island. *Brasenia Schreberi* has only one station north of 45°, at Portage Lake, Maine. While *Nymphaea odorata* fits this category, *N. odorata* var. *gigantea* has only six stations, three in Essex County, Massachusetts, two in Barnstable County, Massachusetts and one on Block Island, Rhode Island. *Actaea rubra* is not recorded from Cape Cod east of Sandwich.

Ib. GENERAL, EXCEPT CAPE COD. — *Stellaria calycantha* and vars. *floribunda* and *isophylla, Actaea pachypoda, Coptis groenlandica, Ranunculus abortivus* var. *acrolasius, R. pensylvanicus, R. trichophyllus* and var. *calvescens.*

Stellaria calycantha itself is infrequent; var. *floribunda* is not found in Rhode Island and has only four stations in Vermont.

IC. GENERAL, EXCEPT CAPE COD AND THE MAINE COAST EAST OF THE KENNEBEC RIVER. —*Nuphar rubrodiscum, Caltha palustris, Ranunculus septentrionalis, Caulophyllum thalictroides. Ranunculus septentrionalis,* is not found in Massachusetts east of the Connecticut valley nor in Rhode Island.

Id. GENERAL, EXCEPT CAPE COD AND WASHINGTON COUNTY, MAINE. — *Claytonia caroliniana, Stellaria longifolia, Nuphar microphyllum, Ranunculus abortivus* var. *eucyclus.* Both *Claytonia caroliniana* and *Stellaria longifolia* are rare in northern Maine with one station each in that area.

II. NORTHERN — NUMEROUS STATIONS SOUTH OF 43°. — *Stellaria Alsine, Ranunculus reptans* and var. *ovalis, Thalictrum polygamum* var. *hebecarpum.*

Stellaria Alsine is not found in northern Maine. *Thalictrum polygamum* var. *hebecarpum* apparantly is absent from Rhode Island and Connecticut.

III. ALPINE-ARCTIC. — *Montia lamprosperma, Sagina nodosa* and var. *pubescens, Arenaria groenlandica* and var. *glabra, Silene acaulis* var. *exscapa, Paronychia argyrocoma* var. *albimontana, Stellaria humifusa.*

Silene acaulis var. *exscapa* is strictly alpine. *Stellaria humifusa* is arctic coming into New England along the eastern Maine coast as far as Hancock County.

IVa. CAPE COD, BUT NOT NORTHERN MAINE-GENERAL IN MAINE SOUTH OF 45°. — *Sagina procumbens, Silene antirrhina, Anemone cylindrica. Anemone cylindrica* apparently occurs in Maine only in the south western part.

IVb. CAPE COD, BUT NOT NORTHERN MAINE-NOT ON MAINE COAST EAST OF THE KENNEBEC RIVER. — *Ranunculus abortivus.*

IVc. CAPE COD, BUT NOT NORTHERN MAINE-SOME NORTH OF 45°, BUT NOT IN WASHINGTON COUNTY. — *Anemone virginiana, Aquilegia canadensis.*

Aquilegia canadensis var. *coccinea* is reported only from Troy, New Hampshire and North Guilford, Connecticut.

V. NEITHER CAPE COD NOR NORTHERN MAINE AND NOT IN WASHINGTON COUNTY. — *Hepatica americana, Ranunculus flabellaris, Thalictrum dioicum.*

VIa. CHIEFLY THE THREE SOUTHERN STATES, BOTH CAPE COD AND WESTERN MASSACHUSETTS. — *Ranunculus sceleratus, Thalictrum revolutum, Lindera Benzoin, Sassafras albidum* and var. *molle.* Except for four stations, *Ranunculus sceleratus* seems to be confined to the coastal area.

VIb. CHIEFLY THE THREE SOUTHERN STATES, CAPE COD BUT NOT WESTERN MASSACHUSETTS. — *Ranunculus ambigens.* This species is mainly coastal but is frequent in the Connecticut valley.

VIc. CHIEFLY THE THREE SOUTHERN STATES, WESTERN MASSACHUSETTS BUT NOT CAPE COD. — *Paronychia canadensis, Silene caroliniana* var. *pensylvanica, Anemonella thalictroides, Ranunculus fascicularis, Liriodendron Tulipifera.* The only station reported for *Silene caroliniana* var. *pensylvanica* in western Massachusetts is in the town of Mt. Washington. *Ranunculus fascicularis* prefers the trap ridges.

VId. CHIEFLY THE THREE SOUTHERN STATES, NEITHER CAPE COD NOR WESTERN MASSACHUSETTS. — *Paronychia fastigiata, Sagina decumbens, Ranunculus micranthus* var. *delitescens. Paronychia fastigiata* is confined to the Connecticut valley and eastern Massachusetts. *Ranunculus micranthus* var. *delitescens* is another species that prefers the trap ridges.

VIe. SOUTHWESTERN NEW ENGLAND CHIEFLY. — *Claytonia virginica, Silene stellata, Cimicifuga racemosa, Ranunculus hispidus* and var. *falsus.*

Silene stellata has one station at Windsor in eastern Vermont. The stations of *Cimicifuga racemosa* at North Berwick, Maine and Enfield, New Hampshire are evidently introduced. *Ranunculus hispidus* var. *falsus* has one outlying station at Bethel in central Vermont.

VII. COASTAL PLAIN. — *Arenaria caroliniana, Magnolia virginiana,* *Arenaria caroliniana* has two stations only at Weekapaug and Westerly, Rhode Island. *Magnolia virginiana* has two stations close together in eastern Essex County, Massachusetts.

VIII. CALCICOLOUS — CHIEFLY WEST OF THE CONNECTICUT RIVER IN THE SOUTH, IF IN EAST MOSTLY NORTH OF 45.° — *Arenaria stricta, Anemone canadensis, A. multifida, A. riparia, Clematis verticillaris, Ranunculus allegheniensis, R. longirostris, R. subrigidus, Thalictrum confine. Arenaria stricta* has a few stations in central New Hampshire. *Anemone canadensis* is evidently an introduction at the numerous stations in eastern Massachusetts. *Clematis verticillaris* is widely distributed,

chiefly away from the coast, but nowhere common. *Ranunculus alleghensis* occurs in the calcareous areas of western New England and is frequent in eastern Massachusetts where there are basic rocks.

IX. WESTERN NEW ENGLAND CHIEFLY. — *Arenaria macrophylla, Cerastium nutans, Nymphaea tuberosa, Hepatica acutiloba, Hydrastis canadensis, Trollius laxus, Podophyllum peltatum, Menispermum canadense.*

Hepatica acutiloba extends sparingly eastwood on sweet soils. It might well be included in the list of calcicolous plants. *Hydrastis canadensis* is very rare with stations at Shelburne and Weybridge, Vermont and Plainville and Southington, Connecticut. *Trollius laxus* is even more local and is apparently confined to northwestern Connecticut at Cornwall, West Cornwall and Canaan.

X. MARITIME HALOPHYTES — IN VICINITY OF COAST, NO ISLAND STATIONS. — *Arenaria peploides* var. *robusta, Spergularia marina* and var. *leiosperma, S. canadensis, Ranunculus Cymbalaria.*

XI. ESTUARINE. — *Nuphar advena.* This species is found at Merrymeeting Bay in Maine and in southwestern Connecticut.

XII. INTRODUCED SPECIES — GENERAL. — *Agrostema Githago, Arenaria serphyllifolia,* and its var. *tenuior, Cerastium vulgatum, Dianthus barbatus, Lychnis alba, L. dioica, Saponaria officinalis, S. Vaccaria, Silene Cucubalus, S. noctiflora, Spergula arvensis, Spergularia rubra, Stellaria graminea, S. media, Ranunculus acris, R. bulbosus, R. repens* and var. *glabratus, Berberis Thunbergii, B. vulgaris.*

Four members of this group have not been reported north of 45°: *Lychnis alba, Saponaria officinalis, Ranunculus bulbosus* and *R. repens; Berberis vulgaris* has only one station north of 45°.

XIIa. INTRODUCED SPECIES — NEITHER CAPE COD NOR NORTHERN MAINE. — *Lychnis chalcedonica, L. Flos-cuculi.*

XIIb. INTRODUCED SPECIES WITH NORTHERN TENDENCIES. — *Aquilegia vulgaris.*

XIIc. INTRODUCED SPECIES WITH SOUTHERN TENDENCIES, CHIEFLY SOUTH OF 43°. — *Portulaca grandiflora, P. oleracea, Cerastium semidecandrum, Dianthus Armeria, D. deltoides, Lychnis Coronaria, Scleranthus annuus, Silene Armeria, S. dichotoma, Cabomba caroliniana, Delphinium Ajacis.*

XIId. INTRODUCED SPECIES — SPORADIC. — *Dianthus plumarius, Gypsophila elegans, G. muralis, G. paniculata, Myosoton aquaticum, Silene gallica, Aconitum Napellus, Ranunculus acris* var. *latisectus, R. repens* var. *erectus,* var. *linearilobus,* var. *pleniflorus,* var. *villosus.*

XIIe. INTRODUCED SPECIES — LOCAL. — *Cerastium viscosum, Holosteum umbellatum, Lychnis Viscaria, Silene conica, S. Cserei, Tunica Saxifraga, Nelumbo lutea, Nigella damascena, Ranunculus Ficaria, Xanthorhiza simplicissima, Akebia quinata, Magnolia acuminata, M. tripetala.*

The following local plants are represented by only one station in New England and it is doubtful if they should be considered as a real part of our flora: *Calandrinia caulescens* var. *Menziesii* collected at

Seekonk, Massachusetts; *Montia perfoliata* at Jefferson, New Hampshire; *Montia sibirica* at Manchester, Massachusetts; *Herniaria glabra* at Bangor, Maine; *Saponaria ocymoides* at Lexington, Massachusetts; *Silene nivea* at Orono, Maine; *S. nutans* at Bar Harbor, Maine; *S. pendula* at Strong, Maine; *Anemone nemorosa* at Danvers, Massachusetts; *Delphinium consolida* at Providence, Rhode Island; *Calycanthus fertilis* at Seymour, Connecticut.

XIII. MISCELLANEOUS. — *Arenaria rubella, Stellaria pubera, Nymphaea tetragona, Ranunculus Gmelini* var. *Hookeri, Thalictrum dasycarpum, T. polygamum* var. *intermedium. Arenaria rubella* is found in New England only at Smuggler's Notch, Vermont. *Stellaria pubera* with a normal range from New Jersey to Illinois southward is recorded from Bethel, Vermont, but questionably so because of insufficient data. Its var. *sylvatica* is probably introduced at its two stations at Norwalk and Wilton, Connecticut. *Nymphaea tetragona* is represented by only three stations, Attean, Perham and Portage Lake, all in Maine. *Ranunculus Gmelini* var. *Hookeri* is a boreal plant found at Presque Isle and New Limerick in Aroostook County, Maine. *Thalictrum dasycarpum* is also outside its normal range and is probably an escape from cultivation at its five known stations in southwestern New England. *Thalictrum polygamum* var. *intermedium* has only two stations in New England — Bristol, Rhode Island and Franklin, Connecticut. — R. C. Bean, A. F. Hill, and R. J. Eaton.

A NEW FORM OF ASTRAGALUS MOLLISSIMUS. —

Astragalus mollissimus Torr., the woolly locoweed, is of frequent occurrence in the western half of Kansas as evidenced by the fact that herbarium specimens exist from each county of the area. The species grows in a wide variety of habitats but is most abundant on rocky, gravelly, prairie hillsides. Of the thousands of specimens observed by me all have had rose-purple to bright purple corollas except for a small colony in Barber County, Kansas, which have yellow corollas. This character has been observed through two seasons. In all other respects the plants are like the species. The yellow-flowered plants may be described as: *Astragalus mollissimus* Torr., forma *flavus* McGregor, forma nov. Ad formam typicam similis, sed petalis flavis. T32S, R14W, Sec. 20, Gypsum Hills prairie, Barber County, Kansas, April 25, 1959, *McGregor 14186* (Type, KANU.) — Ronald L. McGregor, University of Kansas, Lawrence.

Volume 62, No. 735, including pages 61-86, was published April 4, 1960.

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RHODORA

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

REED CLARK ROLLINS, Editor-in-Chief

ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
CARROLL EMORY WOOD, JR.
IVAN MACKENZIE LAMB
} Associate Editors

Vol. 62 May, 1960 No. 737

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Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 62 May, 1960 No. 737

WHAT IS PHYSALIS VARIOVESTITA?

MARGARET Y. MENZEL

In a recent revision of *Physalis* in its United States range, Waterfall (1958) has treated most of the perennial forms with stellate pubescence, including *P. mollis* Nutt. and its varieties, as infraspecific taxa within *P. viscosa* L.[1] This treatment agrees in general with genetic and cytological relationships insofar as they are known (Menzel, 1951, 1957, and unpublished). In regard to this group, Waterfall has retained as a separate species *P. angustifolia* Nutt., which ranges along the northern coast of the Gulf of Mexico, and has distinguished in the Texas population a previously undescribed species, *P. variovestita* Waterfall. The relationships of *P. angustifolia* to *P. viscosa* (*sensu* Rydberg, 1896) have been under study by this investigator (Menzel, 1957) and will be discussed further elsewhere. The purpose of the present note is to record some observations which may bear upon the origin and relationships of *P. variovestita*.

Waterfall's concept of *Physalis variovestita* encompasses plants which are similar to *P. viscosa* ssp. *mollis* (comprising two varieties) but which differ in having abundant long jointed hairs, the hairs simple or branched, in addition to the short, dense, stellate pubescence characteristic of *P. viscosa* ssp. *mollis*. Apparently, it is based upon a single collection. Two collections, from two counties in Texas, are cited in relation to *P. variovestita* as having vestiture approaching the type. Nineteen collections, from fifteen counties in Texas,

[1]As treated by Waterfall, *P. viscosa sens. lat.* comprises (exclusive of formae) (1) ssp. *viscosa;* (2) ssp. *maritima*, including var. *maritima*, var. *elliottii*, and var. *spathulaefolia;* (3) ssp. *mollis* with var. *mollis* and var. *cinerascens*.

are cited as "more widely diverging from *P. variovestita*, but with several to few long jointed trichomes present in addition to the short stellate hairs. . .". Waterfall remarks that the existence of a population (?) of *P. variovestita* could perhaps have been predicted on the basis of the intergrades with *P. viscosa* ssp. *mollis* by Anderson's (1949) method of extrapolated correlates.

Observations of the present investigator indicate that there also exists in Texas (and perhaps as far north as Illinois and Indiana) a rare form of *Physalis*, related in a general way to *P. virginiana* Miller, characterized by a very large (to 4-5 cm. broad), pyramidal, many-ribbed but scarcely angled, fruiting calyx, deeply sunken at the base so that the small fruit is suspended in the middle of the greatly inflated calyx. All of the specimens of this form which I have seen with mature fruit had relatively very large seeds (3-4 mm. in diameter), thereby differing from all other perennial *Physalis* species known to me, in which the seed diameter seldom exceeds 2 mm. *A. A. Heller 1756* (UC, NY) is a representative specimen except that the plants are often somewhat hairier, especially on the new growth, the lower part of the stem, and the calyx. Rydberg (1895) cited this collection from Kerr County, Texas in his description of *P. macrophysa* Rydberg. Waterfall has designated one of the NY sheets as lectotype for *P. virginiana* f. *macrophysa* (Rydb.) Waterfall.

In 1950-52, my husband and I made frequent excursions in company with Dr. H. B. Parks to various parts of Brazos County, Texas in order to become acquainted with the local flora, with which Dr. Parks was intimately familiar. In the course of these field trips, observations were made on *Physalis*, and we found forms resembling what is now called *P. variovestita* common in weedy sites in many parts of the County, usually growing intermingled with forms identifiable with *P. mollis* and indistinguishable from the latter except in vestiture. In a few extreme clones, the short stellate pubescence of *P. mollis* was almost entirely replaced by simple and partly glandular hairs.

Having learned of my interest in *P. macrophysa* and in variations in *P. mollis*, Dr. Parks guided me to two remote sites near the Navasota River, known locally as Long Cross-

ing and Democrat Crossing, where interesting *Physalis* populations occurred.

At Long Crossing, about 5 miles east of Curtin and about 3 miles west of the first of a series of bridges across the swamps of the Navasota River, the (nearly impassable) road had been cut through the crest of a hill, the eastern slope of which led down to the river bottom. The cut had exposed a stratum of red clay for a distance of about 15 feet. In the exposed clay was a single clone, comprising several shoots, of *P. macrophysa*. Along the roadside in both directions, and in open woods on either side of the road, in an area about half a mile in radius, was a large population of plants with characters intergrading between *P. mollis* and *P. macrophysa*. In the intergrades, the indument varied from entirely short and stellate to nearly all long and jointed, with various intermediate combinations; seed size ranged from about 1.8 to about 3.5 mm. in diameter; and there was much variation in size and shape of the fruiting calyx. Plants of the *P. macrophysa* clone had rather large campanulate flowers with five large brown spots, reminiscent of *P. virginiana* and some forms of *P. heterophylla* Nees; the flower buds were lanceolate with the calyx lobes exceeding the corolla by 2-3 mm. In *P. mollis* the flowers are usually smaller, more rotate, and purple- or black-spotted, and the buds are ovate, the calyx lobes scarcely exceeding the corolla. The flower characters of *P. macrophysa* appeared occasionally in the intergrades.

At Democrat Crossing a somewhat similar population occurred except that no clone corresponding exactly to *P. macrophysa* was found. Two clones approached it closely, having seeds 3-3.5 mm. in diameter, large fruiting calyces, and lanceolate buds; the pubescence was dense but composed entirely of simple hairs.[2] One had brown corolla spots, the

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[2]It may be noted that these clones, if isolated as dried specimens from the population in which they occurred, would pass for a rather atypical form of *P. heterophylla*, similar to that noted previously from near Austin, Travis County, Texas (Menzel, 1951, p. 165). Representative specimens are (TEX): *Cohn and Barkley* 13177; *Ferguson* April 20, 1901; *Tharp* April 16, 1927; April 20, 1927; May 5, 1930; *M. S. Young* May 6, 1917; May 12, 1918. Since *P. mollis* is common in Travis County, and *P. macrophysa* has also been collected there (*Tharp* May 6, 1931, TEX, also cited by Waterfall), it seems likely that a population of intergrades between *P. mollis* and *P. macrophysa* may exist in this area.

other purple spots. These two clones appeared to be growing on sandy loam in open woods, but a little work with a shovel revealed that their rootstocks were located about six feet below in red clay. This observation is interesting in view of Dr. Parks' impression that *P. macrophysa* occurs only on "Crockett red clay".

It may be added that at both the above locations, as well as elsewhere in Brazos County, the vast majority of intergrades had many more characters in common with *P. mollis* than with *P. macrophysa*. That is to say, they had characteristics varying between *P. variovestita*, as described, and *P. mollis*, with only a few clones having characteristics between *P. variovestita* and *P. macrophysa*. This is scarcely surprising if one assumes a hybrid origin. Since *P. mollis* is common and *P. macrophysa* very rare, backcrosses to *P. mollis* would necessarily be much more frequent unless some special barrier to crossing intervened.

Attempts to transplant pieces of underground stems from the *P. macrophysa* clone and the *P. macrophysa*-like clones from Democrat Crossing to the garden in College Station, Texas, were unsuccessful. A few seeds collected from *P. macrophysa* in 1951 germinated, but the seedlings soon died. On the other hand, no difficulty was experienced in establishing the more *P. mollis*-like intergrades in the garden; indeed, two such clones occurred there naturally as a well established weed, along with several clones of typical *P. mollis*. In 1951, a freshly opened flower was collected from the *P. macrophysa* clone and used to pollinate ten emasculated flowers of one of the "dooryard" clones of *P. mollis*. Three fruits, containing a total of about 15 plump seeds, matured. The seeds, together with a set of herbarium specimens illustrating the intergradation between *P. mollis* and *P. macrophysa*, unfortunately were lost during the vicissitudes of moving from Texas to Florida.

No cytological analysis of *P. macrophysa* was obtained. Metaphase I in eight clones of the intergrades showed that all of the chromosomes were paired, but that the population was highly heterozygous for chromosome interchanges, in

this respect resembling *P. alkekengi* L. (Gottschalk, 1954) and the *P. viscosa-angustifolia* complex in Florida (Menzel, 1957). One of the *P. macrophysa*-like intergrades from Democrat Crossing showed maximum chromosome association of four bivalents and two rings of eight ($2n=24$), the highest heterozygosity for interchanges so far recorded in *Physalis*.

The information available suggests to the present author that there once existed in Texas a rather extensive population of *P. macrophysa* which has now been nearly swamped by the more aggressive *P. mollis*, but whose former range is adumbrated by variability imposed upon *P. mollis* by introgression of *P. macrophysa* genes.

These preliminary observations are reported here in the hope that they may stimulate someone closer to the scene to undertake a further study of the problem in the field.

The author wishes to thank Dr. R. K. Godfrey for helpful criticism during preparation of the manuscript. — DEPARTMENT OF BIOLOGICAL SCIENCES, FLORIDA STATE UNIVERSITY, TALLAHASSEE, FLORIDA.

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CHROMOSOME NUMBERS IN THE COMPOSITAE II. MEIOTIC COUNTS FOR FOURTEEN SPECIES OF BRAZILIAN COMPOSITAE[1]

B. L. Turner and H. S. Irwin

The junior author of this paper spent 5 months during 1958-59 in south-central Brazil collecting *Cassia* material in connection with a doctoral thesis problem. Since he was routinely collecting bud material of various species of this genus and shipping these air mail to the senior author for meiotic examination, he was able to include, as time and opportunity permitted, occasional bud collections of the family Compositae. The present contribution summarizes the results of a study of this latter material.

METHODS

Chromosome counts were made from pollen mother cell squashes. Buds were collected from plants growing in the field and placed in a freshly mixed solution of 4 parts chloroform; 3 parts absolute alcohol; 1 part glacial acetic acid and allowed to remain for a period varying from several hours to several weeks. All collections were sent air mail from Brazil to Texas where the young anthers were subsequently removed and squashed in acetocarmine. Camera lucida drawings were made at an initial magnification of ca. 2,000 diameters. Voucher specimens (Table 1) are deposited in the University of Texas Herbarium.

OBSERVATIONS

Eupatorieae — The count for *Adenostemma brasilianum* ($n=5$) is the lowest so far reported for the tribe Eupatorieae. Mangenot *et al.*, (1957), reported an African species of this genus as $2n=20$. Apparently the basic number of the genus is $x=5$.

Eupatorium is a large genus with perhaps 400-500 species, widely distributed in the tropical and subtropical regions of the world with relatively few species extending into temperate regions. The two counts reported in the present paper are both in accord with the basic number, $x=10$. *E. kleinioides* ($n=20$) is apparently a tetraploid; however its meio-

[1] This study was supported by National Science Foundation Grant G 9025.

tic configurations, as shown in figure 1, are exceptional in that both asynaptic and paired chromosomes are seen at metaphase I. Paired chromosomes (bivalents), as determined by observations of a number of cells, varied from 4 to 7. Occasional trivalent associations were also seen. Apomixis has been suspected for other polyploid species of *Eupatorium* (Turner and Ellison, 1960; Turner and Beaman, unpubl.), but in such cases meiotic chromosomes have been completely asynaptic. It is possible that *E. kleinioides* is part of an apomictic complex such as exists in the species, *Bouteloua curtipendula* (Harlan, 1949).

Astereae — *Baccharis* is a large, predominantly woody, genus with approximately 600 species widely distributed in the tropical and subtropical regions of the New World (Luis, 1958). Including the present reports, 9 species have been counted (Darlington and Wylie, 1956); all have been diploid with $2n=18$.

Although no certain count could be obtained for *Erigeron maximus* ($n=40\pm4$) it seems significant to report this number, the highest count reported for the approximately 25 species so far investigated. *E. maximus* is the single species of the section Leptostelma and probably has the largest plants of any species in the genus; field notes on the voucher collection reads as follows: "Stout [perennial] herb to 2½ meters." According to label data on another Brazilian collection (*Y. Mexia 4341*, TEX) the species, in certain habitats, reaches 4 meters in height.

Heliantheae — *Acanthospermum australe* ($n=11$) is a weedy species of wide distribution. Carlquist (1954) reported meiotic counts from Hawaiian collections as $n = 10$. Metaphase plates, from which the present counts were made, were particularly clear (figure 3).

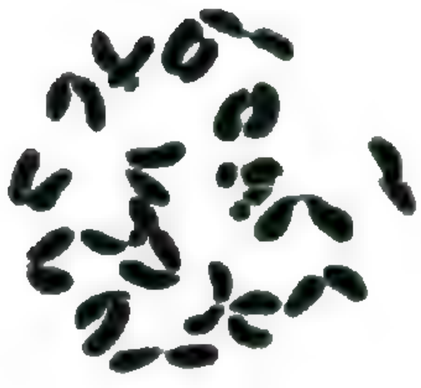
Chromosome counts for *Ambrosia* ($n = 18$) and *Cosmos* ($n=24$) are consistent with those reported for other species in these genera (Wagner & Beals, 1958; Darlington & Wylie, 1956).

Chromosome counts for the closely related taxa *Wedelia* and *Wulffia* are first reports for these genera. Both belong to the subtribe Verbesininae whose genera have been characterized by high basic chromosome numbers. However, in

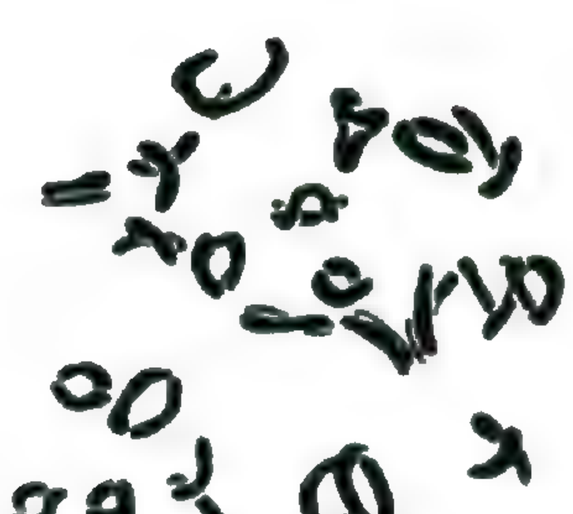
1

2

3



4



5

6

7

8

FIGS. 1-8. Camera lucida drawings of meiotic chromosomes, all approximately 1800. Fig. 1. *Eupatorium kleinioides* ($n = 20$; 7II, 26I). Fig. 2. *Baccharis mela tomifolia* ($n = 9$; anaphase of second division). Fig. 3. *Acanthospermum austra* ($n = 11$). Fig. 4. *Ambrosia polystachya* ($n = 18$). Fig. 5. *Cosmos caudatus* ($n = 24$ Fig. 6. *Wedelia* sp. ($n = 20$). Fig. 7. *Wulffia baccata* ($n = 30 \pm 1$). Fig. 8. *Emil coccinea* ($n = 5$).

view of the numbers listed for *Wedelia* (Table 1), it appears likely that both *Wedelia* and *Wulffia* have the basic number, $x = 10$.

Senecionieae — Baldwin (1946) reported that individuals in five populations of *Emilia coccinea* in the Amazon Valley and one from southern Florida had $2n = 20$. The present count for this species, $n = 5$, is based on material collected at Belo Horizonte in South-central Brazil. Although further study is required, it would appear that two chromosome races of *E. coccinea* exist, diploid and tetraploid. It would be of considerable interest to determine if both races have been introduced from the Old World, or whether one has arisen in the New.

Cooper (1936) reported *Erechtites hieracifolia* to have a count of $2n = 40$, this being interpreted by Darlington and Wylie (1956) as indicative of a basic number $x = 10$ for the genus. The present count of $n = 20$ for *E. valerianaefolia* is in accord with Cooper's report.

TABLE 1. SPECIES OF COMPOSITAE EXAMINED FOR CHROMOSOME NUMBERS

Species	Plant Source and Voucher collection	Chromosome Number
EUPATORIEAE	BRAZIL	
Adenostemma brasilianum Cass.	Minas Gerais. *H. S. Irwin* 2700	$n = 5$
Eupatorium kleinioides H. B. K.	Goiás. *Irwin 2573.*	$n = 20$ (7 II, 26 I)
Eupatorium ligulifolium H. & A.	Minas Gerais. *Irwin 2408.*	$n = 10$
ASTEREAE		
Baccharis melastomifolia H. & A.	Minas Gerais. *Irwin 2258.*	$n = 9$
Baccharis melastomifolia H. & A.	Minas Gerais. *Irwin 2072.*	$2n = 18$
Baccharis trinervis Pers.	Minas Gerais. *Irwin 2648.*	$n = 9$
Erigeron maximus Link & Otto	Minas Gerais. *Irwin 2181.*	$n = 40 \pm 4$
HELIANTHEAE		
Acanthospermum australe (Loefl.) Ktze.	Minas Gerais. *Irwin 2138.*	$n = 11$
Ambrosia polystachya DC.	Minas Gerais. *Irwin 2125.*	$n = 18$
Cosmos caudatus H.B.K.	Minas Gerais. *Irwin 2214.*	$n = 24$
Wedelia sp.	Goiás. *Irwin 2541.*	$n = 20$
Wedelia brasiliensis (Spreng.) Blake	Minas Gerais. *Irwin 2185.*	$n = 29 \pm 1$
Wulffia baccata (L.f.) Ktze.	Minas Gerais. *Irwin 2277.*	$n = 30 \pm 1$
SENECIONIEAE		
Emilia coccinea (Sims) Sweet	Minas Gerais. *Irwin 2337.*	$n = 5$
Erechtites valerianaefolia (Wolf.) DC.	Minas Gerais. *Irwin 2066.*	$n = 20$

SUMMARY

Meiotic chromosome counts are reported for 14 collections of Brazilian Compositae. These include first reports for 13 species and 2 new generic reports (*Wedelia* and *Wulffia*). The highest count yet found for a species of *Erigeron* (*E. maximus*, $n = 40 \pm 4$) is reported. In addition, a count of $n = 11$ for *Acanthospermum australe* was found not to agree with the count of $n = 10$ reported for this weedy species from the Hawaiian Islands. — BOTANY DEPARTMENT, UNIVERSITY OF TEXAS, AUSTIN.

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THE STATUS OF LINDLEY'S AESCULUS NEGLECTA

JAMES W. HARDIN

The shrubby, yellow-flowered buckeye found in the Piedmont of eastern United States has a rather long list of synonyms, but in general it is known as either *Aesculus sylvatica* Bartram or *A. neglecta* Lindley. Deciding which of these names to use has, up until now, involved the controversy over the validity of Bartram's names. In the revision of the American Hippocastanaceae (Brittonia 9:145-171, 173-195. 1957) I decided to accept *A. sylvatica* Bartr. as valid and relegate *A. neglecta* Lindl. to synonymy.

The holotype of *A. neglecta* is in the Botany School Herbarium, University of Cambridge, Cambridge, England. Lindley, in the original description (Edwards Botanical Register 12:1009. 1826), stated that the name was based on a plant purchased by the London Horticultural Society from Monsieur Catros of Bourdeaux. This tree was planted in the garden which was at Chiswick, now part of London. The specimen, labeled as the holotype, has on it "Hort. H. S. 1826" meaning Garden (Hortus) of the Horticultural Society, purchased in 1826. Also on the sheet in script is "*Aesculus neglecta* Nob., May 1826." This specimen also appears to be the one used to make the drawing for t. 1009 of the Botanical Register, which accompanies the original description. I am indebted to Dr. Peter F. Yeo, of the University Botanic Garden, Cambridge, for verifying the validity of this specimen as the holotype and bringing it to my attention in the first place.

Lindley's description fits what we know as *A. sylvatica* with the possible exception of his statements that the calyx is "clothed with black, glandular hairs" and the fact that the specimen was "a handsome hardy small tree." Since, on occasion, *A. sylvatica* is found as a small tree, and sometimes may have small stipitate glands on the calyx, these statements did not arouse very much suspicion when the description was studied. One question of its true nature did arise since Koehne (Deutsche Dendr. 386. 1893) suggested that Lindley's *A. neglecta* was a hybrid between *A. discolor* and *octandra*. Since neither the description nor the illustration indicated characteristics of *discolor* (= *pavia*) this possibility was dismissed.

A recent examination of the holotype of *A. neglecta* revealed the fact that the stipitate glands on the calyx and throughout the pedicel are long and black — a diagnostic feature of *A. octandra*. Also the general aspect of the leaf, in this holotype, approaches that of *A. octandra*. This type specimen is identical to specimens collected by me and identified as *A. octandra* X *sylvatica*, a result of natural hybridization, or introgression, between the two species. The specimen showed no characteristics of *A. pavia*.

The exact origin of this type tree is unknown, but it is possible that either the seed came from an area in Georgia or South Carolina where such hybrids frequently occur, or that the hybrid arose in a garden of Europe, an event that has occurred frequently.

Since Lindley's *A. neglecta* is based on a hybrid between *A. octandra* and *A. sylvatica*, his name must be removed from its place as a synonym of *A. sylvatica* and now be placed in synonymy under the hybrid formula along with *A. glaucescens* Sarg. (see Rhodora **59**:193. 1957). If, on the other hand, a specific epithet is used for this hybrid, then *A.* x *neglecta* (pro. sp.) has priority over *A.* x *glaucescens* (pro. sp.). This would be especially confusing since *A. neglecta* is already well established in the literature for what we call *A. sylvatica*. I have already expressed the view (Brittonia, 1. c.) that formulae instead of specific epithets are better for designating the hybrids and various recombinants encountered in *Aesculus*.

The question that naturally arises at this point is whether or not William Bartram saw the true species or a hybrid form when he described *A. sylvatica*. The disturbing fact is that the areas in which he found this species are ones where hybrids between *sylvatica* and *octandra* or between *sylvatica* and *pavia* are frequently found today. The original description ("floribus ex albo et carneo eleganter variegatis, caule arboreo") is too incomplete to answer this question, and no type is known.

In Bartram's "Travels" (1791) he mentioned finding *A. sylvatica* in the Piedmont of Georgia and the Carolinas. His description, however, is based on a plant found at Ashwood, on the west side of the Cape Fear River, 5 miles northeast of

Council, in Bladen County, North Carolina. This locality is on the Coastal Plain, distinctly east of both the Piedmont and the present distribution of *A. sylvatica*. Bartram mentioned that *A. pavia* was also at Ashwood, and the more recent collections that I have seen from that area are *A. pavia*, *pavia* X *sylvatica* and *sylvatica* (X *pavia*). Many of these last hybrids very nearly approach *A. sylvatica* but have a few characteristics of *A. pavia*. There are two possibilities for the occurrence of this strong element of *A. sylvatica* in this area. First, it is entirely possible that *A. sylvatica* did extend into the Coastal Plain along the bluffs of the Cape Fear River during the time of Bartram's expeditions and has only more recently been limited to the Piedmont. Second, there is the possibility that this plant was not native in that area at all, but had been brought at an early date from the Piedmont and planted there at Ashwood by Colonel Bartram, William's uncle. If the latter is true, then this introduced plant(s) could have hybridized with the native *A. pavia* in the area which would account for the hybrids found there now. In any case, lacking evidence to the contrary, we must assume that Bartram's description was based on *A. sylvatica* and not on a hybrid form.

The British Museum has no specimen of this species collected by Bartram, and further attempts to find the type material have failed. Since, to my knowledge, no types or original material of *A. sylvatica* are in existence, I am therefore designating a *neotype*: Hardin No. 113, 22 April 1953, Union Co., South Carolina. This specimen is preserved in the Herbarium, Department of Botany, North Carolina State College.

In summary, the synonymy now must stand as follows:

1. *Aesculus sylvatica* Bartram, Travels 476. 1791.
   A. neglecta of many authors, not Lindl.
2. *Aesculus octandra* X *sylvatica*
   A. x *neglecta* Lindl. (pro. sp.), in Edwards Bot. Reg. **12**:1009. 1826.
   A. x *glaucescens* Sarg. (pro. sp.), Trees & Shrubs 2:257. 1913.

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NEW COMBINATIONS AND FORMS IN THE MISSOURI FLORA[1]

JULIAN A. STEYERMARK

During the course of preparation of a *Flora of Missouri*, the author has found it necessary to make a number of new combinations. In the present paper only the essential bibliography is given. The reasons for assigning the names to their new status are given in the forthcoming *Flora* or in separate papers.

Trillium pusillum Michx. var. **ozarkanum** (Palmer & Steyerm.) Steyerm., comb. nov. Based on *Trillium ozarkanum* Palmer & Steyerm., Ann. Mo. Bot. Gard. **22**: 504. 1935.

Salix rigida Muhl. var. **rigida** f. **subintegra** (Palmer & Steyerm.) Steyerm., comb. nov. Based on *Salix cordata* Muhl. f. *subintegra* Palmer & Steyerm. in Ann. Mo. Bot. Gard. **25**: 770. 1938.

Carya ovata (Mill.) K. Koch f. **Nuttallii** (Sarg.) Steyerm., comb. nov. Based on *Carya ovata* var. *Nuttallii* Sarg. Trees and Shrubs **2**: 207. 1913.

Carya ovata (Mill.) K. Koch f. **ellipsoidalis** (Sarg.) Steyerm., comb. nov. Based on *Carya ovata* var. *ellipsoidalis* Sarg. Bot. Gaz. 66: 235. 1918.

Carya ovata (Mill.) K. Koch f. **fraxinifolia** (Sarg.) Steyerm., comb. nov. Based on *Carya ovata* var. *fraxinifolia* Sarg. Trees and Shrubs **2**: 207. 1913.

Carya texana Buckl. var. **texana** f. **glabra** (Palmer & Steyerm.) Steyerm., comb. nov. Based on *Carya Buckleyi* Sarg. var. *arkansana* Sarg. f. *glabra* Palmer & Steyerm., Ann. Mo. Bot. Gard. **25**: 770. 1938.

Quercus prinoides Willd. var. **acuminata** (Michx.) Gl. f. **Alexanderi** (Britt.) Steyerm., comb. nov. Based on *Quercus Alexanderi* Britton, Man. Fl. North. States Canada. 336. 1901.

Polygonum virginianum L. var. **glaberrimum** (Fern.) Steyerm., comb. nov. Based on *Tovara virginiana* (L.) Raf. var. *glaberrima* Fern. Rhodora **39**: 404. 1937.

Arabis Shortii (Fern.) Gleason var. **phalacrocarpa** (M. Hopkins) Steyerm., comb. nov. Based on *Arabis dentata* (Torr.) T. & G. var. *phalacrocarpa* M. Hopkins, Rhodora **39**: 169. 1937.

Rubus flagellaris Willd. var. **occidualis** Bailey f. **roseo-plenus** (Palmer & Steyerm.) Steyerm., comb. nov. Based on *Rubus flagellaris* f. *roseo-plenus* Palmer & Steyerm. Brittonia **10**: 114. 1958.

Rubus flagellaris Willd. var. **occidualis** Bailey f. **roseus** Steyerm., f. nov. A forma *roseo-plenus* petalis plerumque quinque roseis differt. — Along low woods in valley of creek tributary to Castor River, T 29 N, R 8 E, sec. 5, 3¾ mi. northwest of Buchanan P. O., Bollinger Co., May 8, 1957, *Steyermark 84212*, HOLOTYPE, in Univ. Mo. Herb.

[1] Work on this paper was completed during the period when the author received grants-in-aid (G 5623, 7117) from the National Science Foundation.

Hypericum punctatum L. var. **pseudomaculatum** (Bush) Fern. f. **flavidum** Steyerm., comb. nov. Based on *Hypericum pseudomaculatum* Bush f. *flavidum* Steyerm. Rhodora **41**: 585. 1939.

Rhododendron roseum (Loisel.) Rehd. f. **albidum** Steyerm., f. nov. A forma *roseum* corollis albidis differt. — Sandy pine-oak woods east of Chimney Rocks, along River Aux Vases, 5 miles east of Pickle, Ste. Genevieve Co., May 24, 1933, *Steyermark 8522*, HOLOTYPE, in Univ. Mo. Herb., ISOTYPE in Herb. Mo. Bot. Gard.

Diospyros virginiana L. var. **pubescens** (Pursh) Dippel f. **pumila** (Palmer & Steyerm.) Steyerm., comb. nov. Based on *Diospyros virginiana* L. f. *pumila* Palmer & Steyerm. Ann. Mo. Bot. Gard. **22**: 616. 1935.

Mertensia virginica (L.) Pers. f. **rosea** Steyerm., f. nov. A forma *virginica* corollis semper roseis recedit. — Rich alluvial woods along north side of Big Creek, T 46 N, R 30 W, sec. 35, 4 mi. southeast of Pleasant Hill, Cass Co., April 17, 1949, *Steyermark 67235*, HOLOTYPE, in Herb. Chi. Nat. Hist. Mus.

In this form, which I have had growing in my wild flower garden for ten years, the corollas are deep pink from bud stage to the end of anthesis, never turning bluish as in typical f. *virginica*.

Physalis longifolia Nutt. var. **hispida** (Waterfall) Steyerm., comb. nov. Based on *Physalis virginiana* var. *hispida* Waterfall, Rhodora **60**: 154-156. 1958

Physalis longifolia Nutt. var. **subglabrata** (Mackenz. & Bush) Steyerm. comb. nov. Based on *Physalis subglabrata* Mackenz. & Bush, Trans. Acad. St. Louis **12**: 86-87. 1902.

Physalis longifolia Nutt. var. **subglabrata** (Mackenz. & Bush) Steyerm. f. **macrophysa** (Rydb.) Steyerm., comb. nov. Based on *Physalis macrophysa* Rydb., Bull. Torrey Club **22**: 308. 1895.

Gerardia flava L. var. **calycosa** (Mackenz. & Bush) Steyerm., comb. nov. Based on *Dasystoma calycosa* Mackenz. & Bush, Rept. Mo. Bot. Gard. **16**: 105. 1905.

Ruellia humilis Nutt. var. **longifolia** (Gray) Fern. f. **alba** (Steyerm.) Steyerm., comb. nov. Based on *Ruellia caroliniensis* (Walt.) Steud. f. *alba* Steyerm. Rhodora **41**: 585. 1939.

Specularia perfoliata (L.) A. DC. f. **alba** (Voigt) Steyerm., comb. nov. Based on *Triodanis* (misspelled Triodanus) *perfoliata* (L.) Nieuwl. f. *alba* Voigt, Fl. S. Ill. 325. 1959.

Solidago arguta Ait. var. **strigosa** (Small) Steyerm., comb. nov. Based on *Solidago strigosa* Small, Fl. Se. U. S. 1198, 1339. 1903.

Solidago arguta Ait. var. **neurolepis** (Fern.) Steyerm., comb. nov. Based on *Solidago neurolepis* Fern. Rhodora **38**: 212-213. 1936.

Antennaria neglecta Greene var. **campestris** (Rydb.) Steyerm., comb. nov. Based on *Antennaria campestris* Rydb. Bull. Torrey Club **24**: 304. 1897.

Heliopsis helianthoides (L.) Sweet var. **occidentalis** (Fisher) Steyerm., comb. nov. Based on *Heliopsis helianthoides* subsp. *occidentalis* Fisher, Ohio Jour. Sci. **57**: 189. 1957.

Helianthus annuus L. var. **lenticularis** (Dougl.) Steyerm., comb. nov. Based on *Helianthus lenticularis* Dougl. in Bot. Reg. *t. 1265*. 1829.

INSTITUTO BOTANICO DEL MINISTERIO DE AGRICULTURA Y CRIA, CARACAS, VENEZUELA.

A MONUMENTAL WORK IS CONCLUDED.[1] — The appearance of Volume Four of the Illustrated Flora of the Pacific States brings to a close a project started over forty years ago by the late Professor LeRoy Abrams. Planned originally in three volumes, this four-volume work in many ways mirrors some of the growth and change in systematic botany during the period. The first volume, published in 1925, was patterned after "An Illustrated Flora of the Northern United States, Canada and the British Possessions" by Britton and Brown. It also followed that work in the use of the "American Code" to govern nomenclatural matters. But four years before volume two was issued in 1944, volume one was corrected to reflect adherence to the "International Rules" and was reissued.

Although it would appear from the publication dates of the last three volumes that these were largely the work of an emeritus professor (Abrams retired in 1940), such is not the case. In the first place, Professor Abrams was actively at work on this Flora from 1910 or thereabouts until 1948, when he became incapacitated by a heart ailment. Secondly, the whole work was not planned to be the product of one man. From the beginning, there were collaborators who contributed the treatments for families or parts of families, genera, etc. This system of obtaining manuscript and sometimes illustrations from specialists was followed throughout the entire work. However, there was one collaborator on the first volume whose role increased in importance as each successive volume appeared, until in the final volume, in the absence of Professor Abrams, she "saw it through" as author. I speak, of course, of Roxana S. Ferris. Mrs. Ferris' whole botanical career has been closely linked to the "Illustrated Flora". In the second volume, she picked up the loose ends and labored with technical matters of all sorts. Then, as Professor Abrams' health failed, she gradually moved into

[1] Illustrated Flora of the Pacific States: Washington, Oregon and California. Volume IV — Bignoniaceae to Compositae, by Roxana Stinchfield Ferris. 1-732. Stanford University Press, Stanford, California. 1960. $17.50.

the gap created by his absence and brought volume three to completion. Finally, with the solid support of Professor Ira L. Wiggins and the rest of the Dudley Herbarium staff, she alone brought together volume four.

As in the other volumes, an important feature of number four has been the participation of outside specialists. The late Dr. S. F. Blake had planned to do the Compositae and, though he was ultimately unable to do so, his influence was transmitted to parts of the volume through notes he supplied and through his supervision of some drawings made by his wife, Doris Holmes Blake. By far the largest number of drawings was made especially for these volumes by Jeanne Russell Janis, whose trademark J has become familiar because of the large number of illustrations she has produced over the years. Her craftsmanship is excellent and the illustrations of the present volume reflect that excellence.

It is not my present purpose to attempt an evaluation of the taxonomic treatments of the various groups covered in volume four. Such an evaluation will really come with the repeated usage of the book against the plants growing in the area covered by it, not from the reviewer's armchair. What I can say is that the book is well printed, well constructed and presents a fine appearance. In the appendix is found a key to the families treated in all four volumes. The user, then, if he does not know the family of the plant he is trying to identify, will reach for volume four to find his guide. Pages 625-652 are an index to common names and pages 653-723 are an index to scientific names; in both indices, all four volumes are included.

Too many large botanical works are never completed. This is understandable when one fully comprehends the enormous amount of effort required. The accomplishment is usually worth the effort but the frequent failures make even more significant those major undertakings that are finally brought to full fruition. In the case of the Illustrated Flora of the Pacific States, nearly two botanical lifetimes, that of LeRoy Abrams and a large part of that of Roxana Ferris, have been devoted to its production. It is a major work and Mrs. Ferris deserves a major salute for finally bringing it to completion — Reed C. Rollins, Gray Herbarium of Harvard University.

TYPIFICATION OF EUPHORBIA MACULATA

Louis Cutter Wheeler

The typification of *Euphorbia maculata* Linnaeus (1753) by the specimen in Linnaeus' Herbarium by Wheeler (1939) has occasioned some discussion both published and unpublished as it changed the sense in which this binomial had been used for perhaps a century. Since it has been two decades since this typification was published, and over a decade since commencement of published discussion, and six years since the publication of the last paper which has come to my attention, a reply to these animadversions can scarcely be considered hasty. Also, having had the opportunity to examine in 1954 the specimens in the Linnaean Herbarium and having discussed the matter with Mr. J. E. Dandy, now Keeper of Botany, British Museum (Natural History), and examined pertinent specimens there too, I have had not only Mr. Dandy's appreciated and helpful counsel but also some firsthand information concerning the taxonomic identities of the specimens involved. In addition, conversations with Wm. T. Stearn in 1954 and more extensively in 1959, combined with Stearn's (1957) invaluable scholarly presentation of Linnaeus' methods and the procedure for choosing the types of his species, have given me some understanding of what is involved. However, I must add that neither of these men is to be blamed for either my conclusions or the means by which they were reached.

It is of fundamental importance in studies involving both biological classification as well as pure nomenclature to be well-acquainted with the organisms involved, otherwise the nomenclature may become confused due to inadequate understanding of biological relationships. It is amazing that authors who have made no detailed study of the species complexes involved in this problem can be so positive concerning the identity of the plant portrayed in a plate which does not show the necessary diagnostic characters. Some of these authors have published very positive opinions concerning the identity of a plant shown in a plate which is so vague that I am uncertain what it represents.

Stripping the problem of all pedantic trappings, there are

the following possibilities for the interpretation of *Euphorbia maculata* L. (The self-evident phrase name and italicized description are omitted both for convenience and because no one known to me has proposed to use them, and disregard the specimens and plate.)

1. The specimen in Linnaeus' herbarium labelled *Euphorbia maculata* by Linnaeus.
2. The plate of Plukenet cited by Linnaeus.
3. The specimen in Linnaeus' herbarium labelled *Euphorbia maculata* by Sir James Edward Smith.

The following table summarizes the views of the various writers on interpretation of *Euphorbia maculata* L.:

Writer	Specimen in hb. L. labelled *maculata* by L.	Plukenet plate	Specimen in hb. L. labelled *maculata* by J. E. S.
Linnaeus 1771	Limits application to this element	Probably intended to exclude	Excludes this concept.
Boissier 1862 pp. 23 & 46	Excludes	Doesn't directly mention	Indicates this is the concept.
Wheeler 1939, 1941, 1960	Takes as type	Uncertain as to identity	Excludes as anachronistic
Svenson 1945	Ignores	Takes as type (in sense of *E. supina* Raf.)	Ignores
Fosberg. 1946, 1947, 1953	Takes as type in 1946 & 1947; excludes in 1953	Identifies 1953 as same as L.'s specimen in left column	Excludes as anachronistic
Croizat 1947 & 1948	Dismisses as excluded by Boissier	Ignores	Takes as type

These items will be discussed *ad seriatim:*

1. The specimen labelled 17 *Euphorbia maculata* by Linnaeus, and still in his herbarium, is believed to have been there in 1753. This belief has, so far as I know, not been questioned. Therefore assuming this to be an accepted valid fact, let us proceed to consider the four objections which have been raised against taking the specimen labelled by Linnaeus as the basis for interpreting the species: (1) it bears the number 17 (that of *E. hypericifolia* in Sp. Pl.); (2) it does not bear number 21 (that of *E. maculata* in Sp. Pl.); (3) it disagrees with the specimen in Linnaeus' herbarium labelled 21 *E. maculata* by Sir James Edward Smith; and (4) it differs from customary usage based on Smith's interpretations.

It is obvious that an error was made by Linnaeus in either the number or the name on the sheet labelled by him (according to Savage 1945, p. 85). In this case Linnaeus subsequently (1771, p. 392) emphasized that *E. maculata* was like *E. hypericifolia*, and this is subsequent confirmation that the name *was as intended*. However, the association of 17 with *maculata* may have been more than a coincidence. It appears that *E. maculata* was extracted, perhaps late in the preparation of the treatment of *Euphorbia*, from the hodge-podge called 17. *E. hypericifolia*.

Euphorbia hypericifolia has been variously interpreted, but its various applications agree in that they are erect, relatively large (at least long) leaved plants. For a time the name was applied to the North American plant, probably on the basis of the change of name made by Sir James Edward Smith: He relabelled the specimen labelled *maculata* by Linnaeus in Linnaeus' herbarium *hypericifolia* (Savage 1945 p. 85.). Putting together the information as to who labelled what specimens with what names (Savage 1945, p. 85) with the account of Sir James Edward Smith's actions given by John Torrey (recounted below) plus my notes taken during my examination of Linnaeus' herbarium in 1954 in the light of the critical comments of Mr. Dandy (in conversation), I now understand not only what I understood in 1939, the explanation of the application of *E. macu-*

lata to the small-leaved prostrate plant called *E. supina* by Rafinesque, but now, in addition, the reason for the name *E. hypericifolia* having been applied for a time to the erect large-leaved plant of eastern North America later known as *E. nutans* Lag. or *E. preslii* Guss., and to which I have returned *E. maculata* L. in its original sense in 1939. First will be quoted the report of Torrey (1843, p. 176.):

"Many years ago, I sent specimens of this and the preceding species to Sir J. E. Smith, who assured me that the former agrees precisely with the original *E. hypericifolia* of *Herb. Linn.*, and that the latter is as certainly *E. maculata.* He also stated, that 'Linnaeus seems to have confounded his original smooth specimens of *E. hypericifolia* (numbered 17 as in *sp. pl. ed.* 1) with *E. maculata:* not that they are at all alike, nor is there any foundation for his remark in the 2nd mantissa, p. 392. The first edition of the *Sp. pl.* is here decisive authority. The original specimen of *E. maculata* is smooth, but there is a downy variety from Jamaica, from Browne's herbarium.'"

The specimen which Smith told Torrey was "original *E. hypericifolia* of *Herb. Linn.*" was the specimen labeled 17 *maculata* by Linnaeus, but relabelled *hypericifolia* by Smith according to the information given by Savage (1945, p. 85). Apparently Smith omitted to mention to Torrey the fact that Smith himself changed the name on the specimen labelled *maculata* by Linnaeus' to *hypericifolia*, nor did Smith tell that the specimen in Linnaeus' herbarium taken by Smith as the authentic specimen of *E. maculata* had been so labelled by Smith, not Linnaeus. Torrey, knowing nothing of Smith's changes, (perhaps occasioned by Linnaeus' specimen bearing the number 17), followed Smith's advice in applying both names. The specimen labelled *maculata* by Smith bore, in Linnaeus' hand, the number 21, the number of *E. maculata* in the Species Plantarum, 1753, but bore no name. Hence Smith supplied the name corresponding to the number.

The problem of typifying *E. hypericifolia* is another Pandora's box to be opened later and elsewhere. However, it is well to take this opportunity to record that my action in 1939 was probably anachronistic, for Savage (1945, p.

vi) shows that Linnaeus' specimen was acquired from Patrick Browne probably in 1758 five years after the Species Plantarum was published. N. E. Brown (1913) chose the same specimen as type!

2. The identity of Plukenet's plate (1691, tab. 65, fig. 8) is uncertain. Mr. Dandy was unable to find in 1954 when I was there at the British Museum (Natural History), any specimen on which the plate might have been based, and the plate itself is so poorly drawn and lacking in diagnostic characters and scale that any identification of it must be speculative. Nevertheless, Svenson (1945) identified it as the small-leaved prostrate plant which Wheeler (1939 & 1941) called *E. supina* Raf. Fosberg (1946) equally confidently concluded that the plate portrays the tall erect large-leaved plant long known as *E. nutans* Lag. or *E. Preslii* Guss. It may be significant that Croizat who has studied *Euphorbia* more than either Svenson or Fosberg, does not, so far as I have seen, attempt to identify the plate of Plukenet. Even though a *specimen* from which Plukenet's plate was drawn were extant, it would not have influenced Linnaeus' concept because Linnaeus, according to Mr. Dandy (in conversation in 1954), did not see Plukenet's *specimens*.

3. Of those known to me to have written on the question, only Boissier and Croizat have taken as type the specimen in Linnaeus' herbarium which was labelled *maculata* by Smith. Croizat (1947, p. 154) stated "This specimen (No. 630.11 in Savage's "Catalogue") is inscribed *21. maculata* in an handwriting which is to all appearances Linnaeus' own." Savage (1945, p. 85) indicated that this specimen was labelled "*maculata*" by Smith. Presumably Boissier, like Croizat, thought Linnaeus had labelled this specimen.

Selection of lectotypes must be on a reasonable basis; the specimen selected must agree with the description. Mere mechanical procedure in which numbers on specimens are used in preference to agreement between the specimen chosen and the description given by its author may lead to grievous error. In this case an error was made by Linnaeus (1753). He had one specimen which he labelled 17 *maculata*, and another which he labelled merely 21, but wrote no name on it. Following the system of numbering used by Linnaeus (described by Stearn 1959 pp. 11 & 12), the specimen

numbered 21 would be the type of *E. maculata* because this is the number of *E. maculata* in the Species Plantarum (Linnaeus, 1753). But in this instance Linnaeus supplied an italicized description which Stern (in conversation, Aug., 1959) assured me means that it was based on a specimen before Linnaeus. This description applies well to the specimen labelled 17 *maculata* by Linnaeus; it fails to apply to either the specimen numbered 21 but left unnamed by Linnaeus, or to the plate of Plukenet cited, as diagnostic characters given could not have been drawn from either of these two: (a) Leaves trinerved — this character is conspicuous in 17, but not evident in 21 and not shown by Plukenet; (b) leaves serrate — the toothing of the leaves is obvious in 17, but in 21 a lens is required to discern the minute serrulations, the leaves of the Plukenet plate are at most minutely and bluntly toothed; (c) cyathia (interpreted as simple flowers by Linnaeus) solitary — this fits 17, but in 21 the cyathia are congested on short branchlets in such a way that they would not have been described by Linnaeus as solitary, though they are so portrayed in the Plukenet plate; (d) "calyx" (involucre) red would characterize 17 but in 21 the cyathia are so small, crowded and obscured by vesture and reduced leaves that the involucre would not give the impression of a red calyx, the Plukenet plate being black and white could not have supplied this character.

Having seen and studied these specimens in the Linnaean Herbarium my conclusions are based on first hand observation, not on photographs or plates. However, for those who might wish to confirm these points without traveling to London, there is available the plate based on a photograph of 17 which Wheeler (1941) and Fosberg (1946) have published. In addition, the entire Linnaean Herbarium is available on microfiche published by the International Documentation Centre, Tunba, Sweden. These photographs, though small, show most of the characters discussed above.

Plukenet's plate is so poorly drawn and lacking in diagnostic characters and scale and indication of habit that it is not susceptible of identification beyond the fact that it portrays an immature plant of *Euphorbia* subgenus *Chamaesyce*, and the interpretation of this plate by some authors as representing a particular species is based on neither the

characters of the Plukenet plate, nor anything in Linnaeus Species Plantarum (1753), nor Linnaeus later elucidation of *Euphorbia maculata* in his Mantissa (1771) as being similar to *E. hypericifolia*, but on association and proximity. (According to Mr. Dandy [conversation, 1954] Linnaeus did not see Plukenet's specimens anyway, so they would not have affected his concept.)

The procedure for selection of types is prescribed in the International Code of Botanical Nomenclature (Lanjouw et al., 1956) Appendix IV. Determination of Types. The selection of lectotypes is outlined under section 4. The selection of the specimen labelled *maculata* by Linnaeus agrees with the prescribed procedure in following subsections as detailed below. (The reader can read for himself in his copy of the Code the provisions of these subsections so they will not be quoted here.) The following statement summarizing the basis for the choice of the specimen of *Euphorbia maculata* in Linnaeus' herbarium labelled *E. maculata* by Linnaeus himself will serve as a basis for judging the validity of this choice:

a. The lectotype was designated, in effect, by the original author, Linnaeus, (1771 p. 392).
b. The lectotype, or perhaps almost holotype, was so far as we have any evidence, in the possession of the original author while he prepared the work in which it was published, and the italicized description fits the specimen.
c. The lectotype designated by the original author is a specimen rather than a pre-Linnaean illustration and description.
d. Since the original author had already, in effect, selected the lectotype, later actions by subsequent authors (Smith and Boissier) are of no validity even though they established usage for a period.
e. Linnaeus, the author of the name, in effect, selected the lectotype first (1771, p. 392). — DEPARTMENT OF BIOLOGY, UNIVERSITY OF SOUTHERN CALIFORNIA, UNIVERSITY PARK, LOS ANGELES 7, CALIFORNIA.

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CALYPSO IN NEW HAMPSHIRE — Though apparently seldom if ever abundant, *Calypso bulbosa* (L.) Oakes is known from various stations in Canada, central and northern Maine, northern Vermont, northern New York, and westward to the Pacific slope, commonly in calcareous swamps of *Thuja occidentalis* L. A scrutiny of the Oakes Ames Orchid Herbarium and of the Gray Herbarium sheets of this species (in which I have been assisted by Mr. Charles Schweinfurth), as well as of the herbarium of the New England Botanical

Club, has revealed no specimens from New Hampshire of this weirdly beautiful little orchid, save for a single sheet in the Club herbarium collected by me in a cedar bog in the township of Columbia on 31 May, 1946 (A.S.P. no. 31887). This sheet has, until very recently, been mislaid, but through the kindness of Mr. R. J. Eaton has now been inserted in its proper place in the Club collection.

My attention was originally directed to the Columbia locality by Mr. T. W. Wallace of Sanford, Maine, whose brother's farm in Columbia is a mile or more distant from the *Calypso*. In 1946, I saw eight or ten plants in bloom, but did not look closely for more. Several years later, on revisiting the region with a friend, I found that extensive logging of the *Thuja* had, apparently, destroyed the orchids. Since that time I have made further but unsuccessful searches in similar swamps in the calciferous mica-schist region of Columbia, Colebrook, Stewartstown, and Clarksville. In this area occur such interesting plants as *Cystopteris bulbifera*, *Carex diandra*, *C. Buxbaumii*, *Eleocharis nitida* (its first United States station is about a mile from the *Calypso*), *Juncus nodosus*, *J. brachycephalus*, *Lobelia Kalmii*, and *Malaxis brachypoda*, of which last the only New Hampshire specimen in the Club herbarium, A.S.P. no.10940, 13 July, 1907, was gathered about a mile away in another direction. — ARTHUR STANLEY PEASE, HARVARD UNIVERSITY.

HELLEBORINE (EPIPACTIS HELLEBORINE) IN MAINE. — In August 1959, while scouting for possible field trip areas for the approaching meeting of the Josselyn Botanical Society, I heard of a strange orchid near the hamlet of Benton Falls on the Sebasticook River. On making a trip there August 16, I was able to locate eight plants of an entirely unfamiliar orchid, which I identified as the above, the identification having been confirmed by Dr. C. D. Richards, Botany Department, University of Maine. This is the first record for Maine. The species is growing under rather widely spaced large white pines on an old pasture site, only a short distance from the end of an old mowing field. All plants were flowering profusely, one with over forty flowers. One pair of stems was browsed off (by deer). The bedrock in this area is shaly,

some a poor grade of slate. The plants are growing nearly one-half mile from the Sebasticook River and about that distance from the nearest roads, and I found no indications of an old house-site in the vicinity. — A. E. BROWER, AUGUSTA, MAINE.

Volume 62, No. 736, including pages 87-116 was issued April 26, 1960.

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RHODORA

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

REED CLARK ROLLINS, Editor-in-Chief

ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
CARROLL EMORY WOOD, JR.
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Vol. 62 June, 1960 No. 738

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

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Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Avenue, Cambridge 38, Mass.

Subscriptions and orders for back issues (making all remittances payable to RHODORA) should be sent to Albert F. Hill, Botanical Museum, Oxford Street, Cambridge 38, Mass.

Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 62 June, 1960 No. 738

THE MOSSES OF MASSACHUSETTS

A COUNTY CATALOGUE WITH ANNOTATIONS[1]

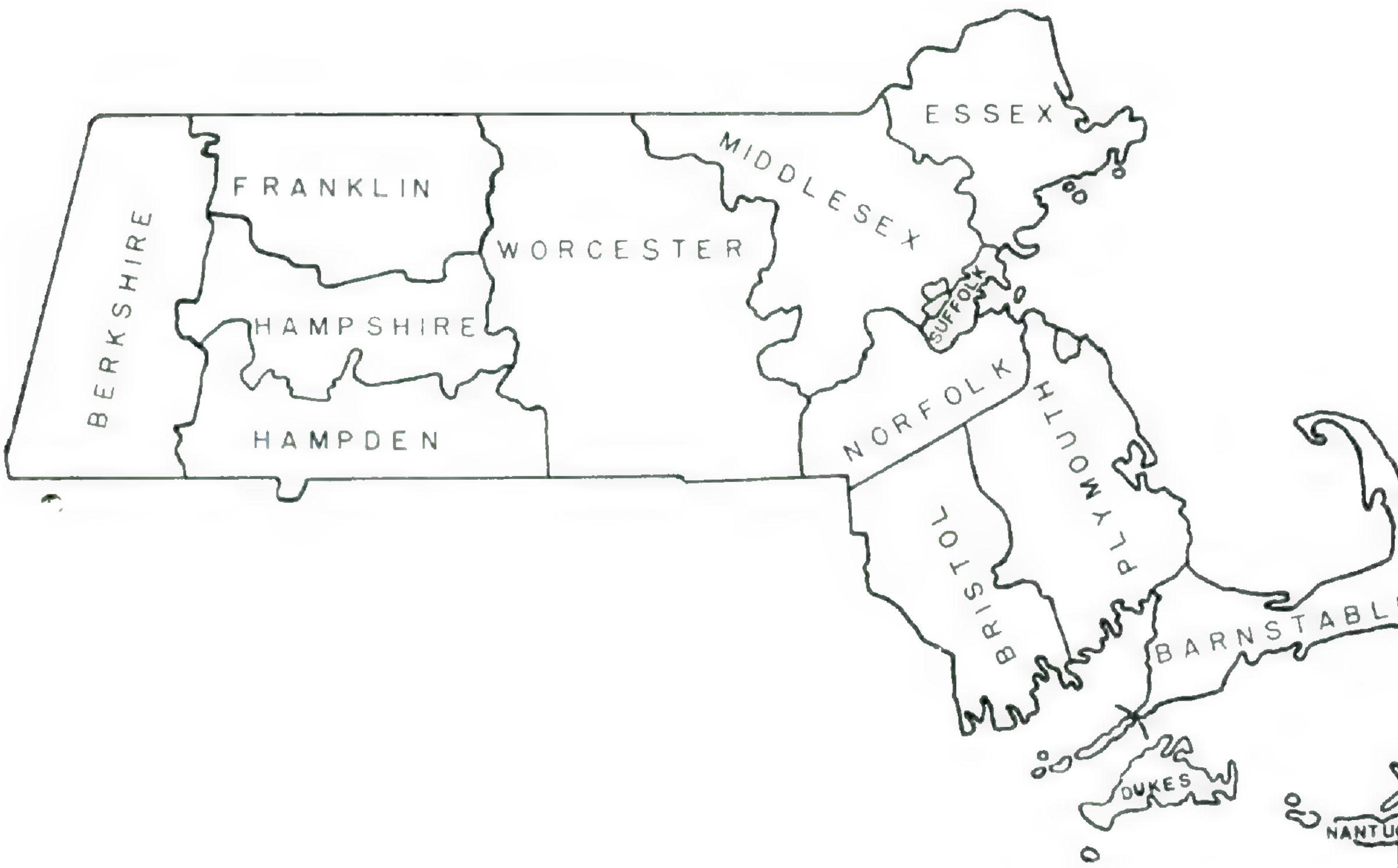
FRANK J. HILFERTY

Since the early nineteenth century, amateur and professional bryologists have collected mosses in Massachusetts and published local lists, but, prior to this report, no one had attempted a catalogue of species and varieties from each of the several counties within the borders of the state. By amalgamating past publications and data obtained from specimens in several herbaria, including his own, the writer hopes to provide bryologists, ecologists, and plant geographers with a useful research tool, and, at the same time, indicate those areas where considerable bryological field work is needed.

Work on this project was begun in October of 1952 and has been pursued somewhat intermittently since that date. In all, over 3,000 specimens of mosses have been examined by the author and specialists in various groups during the past seven years. These plants have been deposited in one or more of the eight herbaria mentioned later in this paper. A preliminary report was presented to the section on Bryology at the IX International Botanical Congress (14) on August 20, 1959. The suggestions received and information given to the author by several bryologists at the Congress were most helpful in completing the work presented here. As a result of research on the mosses of Massachusetts, an article on range extensions for several taxa has been recently published in The Bryologist (15).

[1]Grateful acknowledgement is made to the National Science Foundation for a Faculty Science Fellowship and to Harvard University for an appointment as a Research Fellow in the Gray Herbarium. These appointments have made this publication possible.

As the political, geological, and physiological features of Massachusetts have been described in numerous publications, only a brief note on these matters need be presented here. The state is located in the northeastern portion of the United States between 41° 15′ and 42° 50′ North latitude and extends from 69° 55′ to 73° 30′ West longitude. It encompasses an area of 8,266 square miles, 227 of which are water. The state is divided into counties of varying areas. (See Map 1.) There is considerable topographic variation, with elevations ranging from sea level to 3,535 feet above sea level. In the western section, hills and mountains are characteristic; the central portion is quite hilly; and a flat and somewhat undulating surface marks the eastern and southeastern regions. The numerous ponds and lakes one sees in traveling but a few miles in almost any direction, make it evident that the area was glaciated. Past glaciation and differences in parent rock account for the great diversity of soil types found in Massachusetts.



Map. 1. The counties of Massachusetts.

TABLE 1. THE TAXONOMIC DISTRIBUTION OF THE MOSSES OF MASSACHUSSETTS

Family	*Genera*	*Species*	*Varieties*
Sphagnaceae	1	21	5
Andreaeaceae	1	2	0
Fissidentaceae	1	11	0
Archidiaceae	1	1	0
Ditrichaceae	7	13	0
Seligeriaceae	1	1	0
Dicranaceae	4	20	1
Leucobryaceae	1	2	0
Encalyptaceae	1	2	0
Pottiaceae	13	18	0
Grimmiaceae	2	8	4
Ephemeraceae	1	3	0
Funariaceae	4	5	0
Splachnaceae	2	2	0
Tetraphidaceae	1	2	0
Bryaceae	4	16	1
Mniaceae	1	9	1
Aulacomniaceae	1	3	0
Meesiaceae	1	1	0
Bartramiaceae	2	2	1
Timmiaceae	1	1	0
Ptychomitraceae	2	2	0
Orthotrichaceae	4	14	0
Fontinalaceae	2	8	2
Climaciaceae	1	2	1
Hedwigiaceae	1	1	0
Leucodontaceae	2	4	0
Neckeraceae	3	4	0
Lembophyllaceae	1	1	0
Theliaceae	2	4	1
Fabroniaceae	1	1	0
Leskeaceae	3	5	0
Thuidiaceae	7	13	0
Amblystegiaceae	12	28	4
Brachytheciaceae	9	24	3
Entodontaceae	3	5	0
Plagiotheciaceae	1	8	1
Sematophyllaceae	3	5	0
Hypnaceae	7	18	3
Hylocomiaceae	2	5	0
Buxbaumiaceae	2	3	0
Polytrichaceae	3	13	2
Total	122	311	30

The climate is of the modified continental type and sudden changes in temperature are characteristic of the region. The January average is about 30° F and the July average is approximately 70° F. Boston's mean average temperature is 48° F and the mean is much lower in the interior of the state. Throughout the years, temperatures have ranged from 106° F in the counties of Bristol, Essex and Suffolk; to -28° in Berkshire. Precipitation averages about 40 inches per year.

At this time, the known moss flora, based upon the catalogue of county records only, consists of three orders, 42 families, 122 genera, 311 species, and 30 varieties. (See Table 1.) These numbers include previously published county reports as well as specimens collected by the writer or seen by him in one or more of the previously mentioned herbaria. The number of taxa for which reliable reports exist but for which no specimens could be found follows: four families, 19 genera, 71 species, and eight varieties.

It is interesting to note in passing that the type localities for two species are in Massachusetts, viz. *Orthotrichum stellatum* Brid. in Franklin County and *Pylaisia jamesii* Sull. & Lesq. in Suffolk County.

TABLE 2. NUMBERS OF SPECIES AND VARIETIES FROM THE COUNTIES OF MASSACHUSETTS

County	*Number of taxa*	*County*	*Number of taxa*
Dukes	14	Suffolk	143
Barnstable	45	Worcester	159
Franklin	47	Norfolk	175
Hampden	52	Berkshire	193
Nantucket	58	Essex	204
Hampshire	76	Middlesex	227
Plymouth	87	Bristol	220

Table 2 gives the distribution of species and varieties by county. The great differences in number of taxa in the several counties can be explained in part by the variation in county size, temperature, soil, and precipitation. For example, it is to be expected that a small, windswept island such as Dukes will be poor in species. The author believes, however, that the lack of sufficient exploration in certain counties is the principal reason for the apparent paucity of species in these areas.

Little ecological data are available for most herbarium specimens and the literature supplies scant information on this subject. In view of this situation, it seems best not to attempt any ecological interpretations at this time — they would not be particularly meaningful.

The arrangement of families in the annotated county check list follows that of Brotherus in *Die natürlichen Pflanzenfamilien*, Edition 2 (8). The genera, species, and varieties are arranged alphabetically under each family. Andrews' treatment of the *Sphagnales* in *North American Flora* (5) has been followed and the taxonomy of the *Andreaeales* and the *Bryales* is that of Grout et al., in *Moss Flora of North America, North of Mexico* (12). If a specific or varietal name in the annotated county check list differs from that given in the above treatments, its corresponding name is given in parenthesis following the check list name.

A list of herbaria in Massachusetts which contain most of the species and varieties of mosses listed in this publication is given below. Each herbarium listing is preceded by the code letters used to designate it in the Annotated County Catalogue.

(CUW) Herbarium of the Department of Biology, Clark University, Worcester, Massachusetts.[2]

(EMD) Herbarium of Mrs. Elizabeth M. Dunham, 22 Birch Road, Wellesley, Massachusetts.

(FH) Farlow Library and Herbarium of Cryptogamic Botany, Harvard University, 20 Divinity Avenue, Cambridge, Massachusetts.

(FJH) Herbarium of Frank J. Hilferty, Department of Biological Sciences, State Teachers College, Bridgewater, Massachusetts.

(MASS) Herbarium of the Department of Botany, Clark Hall, University of Massachusetts, Amherst, Massachusetts.

(NEBC) Herbarium of the New England Botanical Club, Inc., c/o The Gray Herbarium, Harvard University, 22 Divinity Avenue, Cambridge, Massachusetts.

(PM) Herbarium of the Peabody Museum, Essex Street, Salem, Massachusetts.

(WELC) Herbarium of the Department of Botany, Wellesley College, Wellesley, Massachusetts.

Annotated County Catalogue

In the following catalogue, the county or counties for

[2]Most of the moss specimens in this herbarium were examined when they were in the Worcester Natural History Society's Museum at 21 Cedar Street, Worcester, Massachusetts. The Society has since donated its moss collection to Clark University.

which herbarium specimens or literature reports have been seen are given for each species and variety. The numbers refer to published reports which are listed at the end of this paper under Literature Cited. Literature reports designated by their authors as "doubtful" have been excluded. Herbaria in which specimens of each taxon may be found follow the numbers.

SPHAGNACEAE

Sphagnum capillaceum (Weiss) Schrank — Barnstable (EMD, FH, NEBC, WELC); Berkshire (1); Bristol (13, 21, FH, NEBC); Essex (22, 23, EMD, FH,); Hampden (CUW); Middlesex (10, 27, EMD, FH, NEBC, WELC); Norfolk (11, FH, NEBC); Suffolk (11); Worcester (WELC, MASS).

S. capillaceum var. *tenellum* (Schimp.) Andrews — Barnstable (FH); Essex (EMD, FJH); Norfolk (11); Suffolk (11); Worcester (WELC).

S. compactum DC. — Berkshire (2); Bristol (13); Middlesex (FH, NEBC); Plymouth (23); Worcester (EMD).

S. cuspidatum Ehrh. — Barnstable (FH); Berkshire (2); Bristol (13, NEBC); Essex (22, EMD, FH, PM); Middlesex (FH, NEBC); Nantucket (19, 20, FH, NEBC); Norfolk (11, NEBC); Suffolk (11); Worcester (25, MASS, WELC).

S. cuspidatum var. *torreyi* (Sull.) Braithw. — Barnstable (FH, NEBC); Bristol (FH); Essex (22, EMD, FH, NEBC, PM); Middlesex (EMD, FH, FJH, NEBC); Norfolk (EMD, FH, NEBC); Suffolk (NEBC).

S. cyclophyllum Sull. & Lesq. — Bristol (13).

S fimbriatum Wils. — Barnstable (NEBC); Bristol (21); Essex (FH, NEBC, PM); Middlesex (FH, NEBC); Norfolk (FH, NEBC); Worcester (EMD, FH, NEBC).

S. flavicomans (Card.) Warnst. — Barnstable (15, FH); Norfolk (15, FH, NEBC).

S. fuscum (Schimp.) Klinggr. — Berkshire (6).

S. girgensohnii Russ. — Barnstable (FH, NEBC); Berkshire (CUW); Essex (PM); Middlesex (EMD, FH); Norfolk (11, FH); Worcester (NEBC).

S. imbricatum Hornsch. — Barnstable (FH, NEBC); Bristol (FH, NEBC); Dukes (FH, NEBC); Essex (FH, PM); Middlesex (EMD, FH, NEBC); Nantucket (FH); Norfolk (11, FH, FJH, NEBC); Suffolk (11, FH).

S. imbricatum var. *affine* (Ren. & Card.) Warnst. — Barnstable (15, NEBC); Essex (15, FH, NEBC, PM); Middlesex (15, EMD, FH, NEBC); Norfolk (15, NEBC); Suffolk (15, NEBC); Worcester (15, EMD, FH).

S. macrophyllum Bernh. — Barnstable (15, NEBC); Plymouth (15, NEBC).

S. magellanicum Brid. — Barnstable (FH); Berkshire (2); Essex (FH, NEBC, PM); Middlesex (EMD, FH, NEBC); Nantucket (20); Norfolk (11, FH, FJH, NEBC); Suffolk (11); Worcester (FH).

S. palustre L. — Barnstable (FH, NEBC, WELC); Berkshire (1, 16, FH, NEBC); Bristol (13, 21, NEBC); Dukes (WELC); Essex (22, 23, EMD, FH, NEBC, PM, WELC); Hampshire (MASS); Middlesex (10, 27, EMD, FH, NEBC); Nantucket (20, FH, NEBC); Norfolk (11, CUW, FH, NEBC, WELC); Plymouth (WELC); Suffolk (11, FH, NEBC); Worcester (25, EMD, FH, FJH, MASS, NEBC).

S. papillosum Lindb. — Barnstable (FH, NEBC); Dukes (FH, NEBC); Essex (22); Middlesex (EMD, FH); Norfolk (NEBC).

S. plumulosum Röll. — Barnstable (15, NEBC); Essex (15, NEBC, PM); Norfolk (NEBC); Worcester (15, CUW).

S. recurvum P. Beauv. — Barnstable (FH, NEBC); Berkshire (2); Bristol (FH); Dukes (WELC); Essex (EMD, FH, NEBC, PM); Hampden (FH, NEBC, WELC); Middlesex (EMD, FH, NEBC); Nantucket (20); Norfolk (11, FH, NEBC, WELC); Suffolk (11); Worcester (EMD, FH).

S. recurvum var. *tenue* Klinggr. — Nantucket (20).

S. robustum (Russ.) Roell. — Berkshire (6).

S. squarrosum Crom. — Berkshire (1, FH); Bristol (13, 21); Essex (EMD, NEBC); Middlesex (10, 22, 23, EMD, FH); Nantucket (19, FH); Norfolk (EMD, WELC).

S. subsecundum Nees — Barnstable (FH, NEBC); Bristol (13, 21); Essex (22, EMD, FH, NEBC, PM); Hampden (NEBC); Middlesex (10, EMD, FH, NEBC); Nantucket (FH); Norfolk (11, FH, NEBC, WELC); Suffolk (11, FH, NEBC); Worcester (EMD).

S. tenellum Pers. — Essex (15, FH, NEBC, PM); Middlesex (15, FH, NEBC); Norfolk (15, FH, NEBC); Suffolk (15, FH, NEBC).

S. tenerum Sull. & Lesq. — Barnstable (NEBC); Berkshire (2).

S. teres (Schimp.) Aongstr. — Essex (15, PM); Hampden (15, NEBC); Middlesex (15, EMD, FH); Norfolk (15, FH, NEBC); Worcester (15, FH).

S. warnstorfianum DuRietz *(S. warnstorfii)* — Berkshire (6).

ANDREAEACEAE

Andreaea rothii Web. & Mohr — Berkshire (WELC); Bristol (13, NEBC); Essex (EMD, FH, NEBC); Middlesex (FH, NEBC); Norfolk (11); Suffolk (11, FH, NEBC); Worcester (EMD, FJH).

A. rupestris Hedw. — Berkshire (4); Norfolk (11, FH).

FISSIDENTACEAE

Fissidens adiantoides Hedw. — Berkshire (1); Bristol (13, NEBC); Essex (22, PM); Franklin (MASS); Hampden (WELC); Middlesex (10, 11, 23, 27, EMD, FH, FJH, NEBC, WELC); Norfolk (FH); Plymouth (23); Suffolk (11); Worcester (23).

F. bryoides Hedw. — Bristol (13); Franklin (FH); Middlesex (FH); Norfolk (FH).

F. bushii Card. & Thér. — Bristol (15, NEBC).

F. cristatus Wils. — Berkshire (1, EMD); Bristol (NEBC, WELC); Essex (FH, NEBC); Hampshire (MASS); Middlesex (FH); Norfolk (WELC); Worcester (FH).

F. debilis Schwaegr. (*F. julianus*) — Essex (FH, NEBC, PM); Middlesex (11, CUW); Plymouth (EMD); Worcester (CUW).

F. exiguus Sull. — Middlesex (10, 27).

F. minutulus Sull. — Berkshire (4); Bristol (13, NEBC); Essex (EMD); Middlesex (NEBC); Worcester (FH, NEBC).

F. osmundioides Hedw. — Berkshire (6); Bristol (13, NEBC); Essex (22, FH, NEBC, PM); Hampden (WELC); Middlesex (10, 11, EMD, FH, FJH, NEBC); Norfolk (WELC); Suffolk (28).

F. subbasilaris Hedw. — Bristol (13).

F. taxifolius Hedw. — Berkshire (2, NEBC); Essex (22, NEBC); Middlesex (11, FH); Suffolk (11, NEBC, WELC).

F. viridulus (Web. & Mohr) Wahlenb. — Middlesex (15, FH, WELC); Norfolk (15, WELC).

ARCHIDIACEAE

Archidium alternifolium (Hedw.) Schimp. — Bristol (13).

DITRICHACEAE

Bruchia flexuosa (Sw.) C. Muell. — Bristol (13); Norfolk (FH); Suffolk (NEBC).

B. sullivanti Aust. — Bristol (13); Essex (FH, NEBC); Middlesex (EMD, FH); Norfolk (FH); Suffolk (FH); Worcester (WELC).

Ceratodon purpureus (Hedw.) Brid. — Barnstable (NEBC); Berkshire (1); Bristol (13, 21, FH, NEBC, WELC); Essex (22, FH, NEBC, PM); Franklin (NEBC); Hampden (FH, NEBC); Hampshire (CUW, NEBC); Middlesex (10, 27, EMD, FH, NEBC); Nantucket (20, FH); Norfolk (11, FH, FJH, NEBC, WELC); Plymouth (NEBC); Suffolk (11, 28, FH, NEBC); Worcester (CUW, FH, NEBC, WELC).

Distichium capillaceum (Hedw.) B. S. G. — Essex (22, 23); Plymouth (23).

Ditrichum lineare (Sw.) Lindb. — Berkshire (2); Bristol (13, NEBC); Essex (FH); Hampden (MASS); Middlesex (10, 27, FH, NEBC); Norfolk (11, FH, WELC); Suffolk (11, NEBC, WELC).

D. pallidum (Hedw.) Hamp. — Barnstable (FH); Berkshire (16); Bristol (13, FH, NEBC); Essex (22, EMD, FH, NEBC); Franklin (NEBC); Hampden (FH); Middlesex (10, 27, EMD, FH, NEBC); Nantucket (FH); Norfolk (11, FH, WELC); Plymouth (23, FH); Suffolk (11, 23, 28, NEBC); Worcester (FH, NEBC, WELC).

D. pusillum (Hedw.) Britt. — Berkshire (CUW); Bristol (13, NEBC); Essex (22, FH, PM); Hampden (WELC); Hampshire (EMD); Middlesex (10, 27, EMD, FH, NEBC); Norfolk (FH, FJH, NEBC, WELC); Suffolk (11, CUW, NEBC); Worcester (WELC).

Pleuridium acuminatum Lindb. — Bristol (21); Nantucket (20).

P. palustre (Bruch & Schimp.) B. S. G. — Bristol (NEBC).

P. subulatum (Hedw.) Lindb. — Bristol (13); Essex (FH, NEBC); Middlesex (EMD, FH, WELC); Norfolk (EMD, FH, WELC); Plymouth (23); Suffolk (EMD, FH); Worcester (CUW, NEBC).

Saelania glaucescens (Hedw.) Broth. — Bristol (13, NEBC).

Trematodon ambiguus (Hedw.) Hornsch. — Bristol (13, NEBC); Essex (FH, NEBC); Worcester (MASS).

T. longicollis Michx. — Franklin (16); Suffolk (NEBC).

SELIGERIACEAE

Blindia acuta (Hedw.) B. S. G. — Suffolk (23).

DICRANACEAE

Dicranella cerviculata (Hedw.) Schimp. — Worcester (15, NEBC, WELC).

D. heteromalla (Hedw.) Schimp. — Berkshire (1, 16, CUW, FH, NEBC); Bristol (13, 21, NEBC); Essex (FH, NEBC); Hampden (NEBC); Middlesex (10, 27, FH, NEBC); Norfolk (11, FH, FJH, NEBC); Plymouth (BC, NEBC); Suffolk (11, FH, NEBC); Worcester (FH, NEBC).

D. heteromalla var. *orthocarpa* (Hedw.) Par. — Barnstable (FH); Berkshire (16); Bristol (EMD, FH); Essex (EMD, FH, NEBC, PM); Hampshire (EMD, FJH); Middlesex (EMD, NEBC); Nantucket (20); Norfolk (FH, NEBC, WELC); Worcester (WELC).

D. rufescens (Sm.) Schimp. — Bristol (13).

D. schreberiana (Hedw.) Schimp. *(D. schreberi)* — Berkshire (15, NEBC).

D. varia (Hedw.) Schimp. — Berkshire (1); Bristol (13); Essex (NEBC, PM); Hampshire (MASS); Middlesex (23, 27); Plymouth (23); Worcester (WELC).

Dicranum bergeri Bland. — Berkshire (3); Essex (17, 22, FH, NEBC); Middlesex (10, CUW, FH); Nantucket (FH); Norfolk (11); Suffolk (11, CUW); Worcester (EMD, FH, NEBC).

D. bonjeanii De Not. — Essex (17).

D. condensatum Hedw. — Bristol (EMD); Essex (EMD); Nantucket (20).

D. drummondii C. Muell. — Berkshire (CUW); Bristol (13, NEBC); Essex (17, FH, NEBC, PM); Middlesex (10, NEBC); Norfolk (CUW, FH, NEBC); Plymouth (FH); Suffolk (NEBC); Worcester (NEBC).

D. flagellare Hedw. — Barnstable (FJH); Berkshire (2); Bristol (13, 21, FH, NEBC); Dukes (NEBC); Essex (22, 23, FH, NEBC, PM); Franklin (FH); Middlesex (10, 27, EMD, FH, NEBC); Nantucket (20); Norfolk (11, EMD, FH, WELC); Plymouth (23, FH); Suffolk (11); Worcester (CUW, FH).

D. fulvum Hook. — Berkshire (2, CUW, FH, NEBC, WELC); Bristol (13, 21); Essex (22, FH, PM); Hampden (FH, WELC); Hampshire (NEBC); Middlesex (10, EMD, FH, NEBC); Norfolk (11, CUW, FH, NEBC, WELC); Suffolk (11, NEBC); Worcester (FH, NEBC).

D. fuscescens Turn. — Barnstable (FH); Berkshire (1); Bristol (13); Dukes (EMD); Essex (22, FH, NEBC); Middlesex (27); Norfolk (11, FH, WELC); Suffolk (11, FH).

D. montanum Hedw. — Berkshire (3, CUW); Bristol (13, 21); Essex (17, 22, CUW, FH, NEBC, PM); Middlesex (EMD, FH); Norfolk (11, FH, NEBC); Suffolk (11); Worcester (CUW, FH, NEBC, WELC).

D. muehlenbeckii B. S. G. — Berkshire (15, FJH).

D. rugosum (Hoffm.) Brid. — Bristol (13, NEBC); Essex (17, 22, 23, FH, NEBC, PM); Middlesex (10, 23, 27, NEBC); Norfolk (11, FH); Plymouth (FH); Suffolk (11, NEBC); Worcester (FH, NEBC).

D. scoparium Hedw. — Barnstable (FH, FJH, NEBC); Berkshire (1, 2,

7, 16); Bristol (13, 21, FH, NEBC); Dukes (WELC); Essex (17, 22, 23, CUW, FH, NEBC, PM); Franklin (MASS); Hampden (FH, NEBC); Middlesex (10, 23, 27, EMD, FH, FJH, NEBC, WELC); Nantucket (20, FH, NEBC); Norfolk (11, FH, FJH, NEBC, WELC); Plymouth (23, FH, NEBC); Suffolk (11, CUW, NEBC); Worcester (CUW, FH, MASS, NEBC).

D. spurium Hedw. — Bristol (13); Essex (EMD, FH); Middlesex (10, NEBC); Norfolk (11, CUW, FH, NEBC); Suffolk (11, NEBC).

D. viride (Sull. & Lesq.) Lindb. — Berkshire (3); Essex (17, FH, NEBC); Middlesex (10, NEBC); Norfolk (CUW, FH, NEBC); Suffolk (NEBC); Worcester (CUW).

Oncophorus wahlenbergii Brid. — Bristol (13); Essex (FH); Middlesex (FH, WELC).

Paraleucobryum longifolium (Hedw.) Loesk. — Berkshire (1, CUW, FH, NEBC); Essex (FH); Middlesex (10, 23).

LEUCOBRYACEAE

Leucobryum albidum (Brid.) Lindb. — Bristol (13); Middlesex (10, 27, NEBC).

L. glaucum (Hedw.) Schimp. — Barnstable (NEBC); Berkshire (1, 16, CUW, NEBC); Bristol (13, 21, NEBC); Essex (22, 23, FH, FJH, NEBC, PM, WELC); Hampden (NEBC); Hampshire (EMD, MASS); Middlesex (10, 11, 27, EMD, FH, NEBC); Nantucket (20, FH); Norfolk (11, CUW, FH, FJH, WELC); Suffolk (11, 23, NEBC); Worcester (EMD, FH, NEBC).

ENCALYPTACEAE

Encalypta ciliata Hedw. — Berkshire (EMD); Franklin (16).

E. streptocarpa Hedw. — Hampshire (15, MASS); Worcester (15, CUW, EMD).

POTTIACEAE

Acaulon muticum (Hedw.) C. Muell. — Bristol (13).

A. triquetrum (Spruc.) C. Muell. — Bristol (13).

Astomum muehlenbergianum (Sw.) Grout — Bristol (13); Middlesex (EMD, FH); Norfolk (NEBC); Suffolk (EMD, FH).

Barbula convoluta Hedw. — Bristol (13).

B. unguiculata Hedw. — Berkshire (1); Bristol (13, NEBC); Essex (FH, PM); Hampshire (MASS); Middlesex (10, 27, EMD, FH); Norfolk (FH, NEBC); Plymouth (23); Suffolk (11).

Bryoerythrophyllum recurvirostre (Hedw.) Chen (*Didymodon recurvirostris*) — Plymouth (23).

Didymodon rigidulus Hedw. — Berkshire (4).

Gymnostomum aeruginosum Sm. — Berkshire (6).

Hymenostylium recurvirostrum (Hedw.) Dix. (*Gymnostomum recurvirostrum*) — Berkshire (6).

Phascum cuspidatum Hedw. — Bristol (13); Nantucket (20).

Pottia truncata (Hedw.) Fuernr. — Bristol (13); Essex (22, 23, NEBC, PM); Middlesex (10, 23, CUW, EMD, FH, NEBC); Norfolk (11, EMD, FH, NEBC); Plymouth (FH); Suffolk (11, FH, NEBC).

Tortella humilis (Hedw.) Jenn. (*T. caespitosa*) — Bristol (13, NEBC); Essex (NEBC, PM); Hampden (FH, WELC); Middlesex (10, 27, EMD, NEBC); Norfolk (11, FH, FJH, NEBC, WELC).

T. tortuosa (Hedw.) Limpr. — Berkshire (15, EMD); Essex (15, FH, NEBC); Franklin (15, MASS); Hampshire (15, MASS).

Tortula papillosa Wils. — Bristol (13, 21); Essex (22, FH, NEBC); Middlesex (EMD, FH, NEBC); Norfolk (11, FH, NEBC); Suffolk (NEBC).

T. ruralis (Hedw.) Sm. — Essex (22).

Trichostomum tenuirostre (Hook. & Tayl.) Lindb. *(T. cylindricum)* — Berkshire (6).

Weisia controversa Hedw. (*W. viridula*) — Berkshire (16, CUW, WELC); Bristol (13, NEBC); Essex (22, EMD, FH, PM); Hampshire (MASS); Middlesex (10, 23, 27, FH, NEBC); Norfolk (11, FH, WELC); Plymouth (23, NEBC); Suffolk (11, FH, NEBC).

W. microstoma (Hedw.) C. Muell. — Middlesex (12).

GRIMMIACEAE

Grimmia apocarpa Hedw. — Berkshire (2, FH, NEBC); Bristol (13, NEBC); Essex (22, 23, NEBC, PM); Middlesex (10, 27, EMD, FH, NEBC, WELC); Norfolk (11, FH, NEBC, WELC); Suffolk (11, WELC); Worcester (CUW, WELC).

G. apocarpa var. *alpicola* (Hedw.) Hartm. (*G. alpicola*) — Berkshire (CUW); Bristol (13); Essex (12); Middlesex (NEBC); Worcester (CUW, NEBC).

G. apocarpa var. *conferta* (Funck) Spreng. — Essex (FH, WELC); Hampshire (MASS); Middlesex (10, 27, EMD, NEBC, WELC); Norfolk (11, FH, NEBC, WELC); Suffolk (11, CUW, FH, NEBC).

G. doniana Sm. — Hampshire (15, MASS).

G. laevigata (Brid.) Brid. — Bristol (13).

G. maritima Turn. — Bristol (13); Essex (22, 23, CUW, EMD, FH, NEBC, PM).

G. olneyi Sull. — Bristol (13, NEBC); Essex (FH); Middlesex (10, NEBC); Norfolk (11, FH, NEBC, WELC); Suffolk (11, CUW, FH, NEBC, WELC).

G. pilifera P. Beauv. — Bristol (13, NEBC); Essex (FH); Middlesex (10, NEBC); Norfolk (11, 23, CUW, NEBC); Plymouth (23); Suffolk (11, NEBC, WELC).

Rhacomitrium aciculare (Hedw.) Brid. — Berkshire (1, FH, NEBC); Bristol (13, NEBC); Essex (FH); Hampshire (MASS); Middlesex (FH); Norfolk (11, CUW, FH, NEBC, WELC); Suffolk (11); Worcester (CUW, NEBC).

R. heterostichum (Hedw.) Brid. — Berkshire (6).

R. heterostichum var. *ramulosum* (Lindb.) Jones — Bristol (13).

R. heterostichum var. *sudeticum* (Funck) Jones — Berkshire (2, FJH, WELC); Bristol (13); Essex (FH); Middlesex (10, 11, WELC); Norfolk (11, FH, NEBC, WELC); Plymouth (FH); Suffolk (11, WELC); Worcester (18).

EPHEMERACEAE

Ephemerum crassinervium (Schwaegr.) Hamp. — Bristol (13).

E. serratum (Hedw.) Hamp. — Essex (NEBC); Middlesex (10, 12, FH).

E. spinulosum Schimp. — Bristol (15, NEBC); Essex (15, PM); Middlesex (15, EMD, FH).

FUNARIACEAE

Aphanorhegma serratum (Hook. & Wils.) Sull. — Bristol (13); Middlesex (10, 23).

Funaria flavicans Michx. — Berkshire (16).

F. hygrometrica Hedw. — Barnstable (NEBC); Berkshire (1, 16); Bristol (13, 21, FH, NEBC); Essex (22, 23, FH, NEBC, PM); Middlesex (10, 11, 23, 27, EMD, FH, FJH, NEBC); Nantucket (20); Norfolk (11, FH, FJH, NEBC, WELC); Plymouth (23); Suffolk (11, 28, FH, NEBC, WELC); Worcester (FH, MASS, NEBC, WELC).

Physcomitrella patens (Hedw.) B. S. G. (*Aphanorhegma patens*) — Middlesex (10, 23).

Physcomitrium pyriforme Brid. (*P. turbinatum*) — Berkshire (1); Bristol (13, 21, NEBC); Essex (22, 23, NEBC, PM); Hampshire (WELC); Middlesex (10, EMD, FH, NEBC); Nantucket (20); Norfolk (11, FH, FJH, NEBC, WELC); Suffolk (11, 28, CUW, NEBC); Worcester (CUW, MASS, NEBC).

SPLACHNACEAE

Splachnum ampullaceum Hedw. — Essex (22, 23); Hampshire (NEBC).

Tetraplodon pennsylvanicus (Brid.) Grout — Bristol (13); Worcester (NEBC).

TETRAPHIDACEAE

Tetraphis geniculata Girgens. — Bristol (13); Essex (FH).

T. pellucida Hedw. — Berkshire (1, FH, NEBC); Bristol (21, NEBC); Essex (22, 23, FH, NEBC, PM); Franklin (MASS); Hampden (NEBC, WELC); Hampshire (MASS); Middlesex (10, 27, EMD, FH, NEBC, WELC); Nantucket (20); Norfolk (11, FH, FJH, NEBC, WELC); Plymouth (23, NEBC); Suffolk (11); Worcester (EMD, FH, NEBC).

BRYACEAE

Bryum angustirete Kindb. (*B. pendulum*) — Berkshire (6).

B. argenteum Hedw. — Berkshire (1, 16); Bristol (13, 21, FH, NEBC); Essex (22, 23, FH); Middlesex (10, 27, EMD, FH, NEBC); Nantucket (20); Norfolk (11, FH, FJH, WELC); Plymouth (NEBC); Suffolk (11, NEBC); Worcester (EMD, FH, WELC).

B. argenteum var. *lanatum* (P. Beauv.) B. S. G. — Norfolk (15, FH).

B. caespiticium Hedw. — Berkshire (1, 16); Bristol (13, NEBC); Essex (22, 23, FH, NEBC, PM); Hampshire (CUW, FH); Middlesex (10, 27, FH, NEBC); Norfolk (11, FH, NEBC); Plymouth (NEBC); Suffolk (11, 28, NEBC).

B. capillare Hedw. — Berkshire (3, CUW); Bristol (13, 21); Essex (FH); Middlesex (10, 23); Norfolk (11, FH); Suffolk (11); Worcester (CUW, WELC).

B. creberrimum Tayl. (*B. cuspidatum*) — Berkshire (3, 16); Bristol (13); Essex (22); Middlesex (10, 27).

B. pseudotriquetrum (Hedw.) Schwaegr. (*B. bimum*) — Berkshire (1, 3, CUW, FH, NEBC); Bristol (13, NEBC); Essex (22, CUW, FH, PM);

Hampden (FH); Middlesex (10, 27, FH); Norfolk (11, CUW, FH, NEBC); Plymouth (FH); Suffolk (11, NEBC); Worcester (MASS).

Leptobryum pyriforme (Hedw.) Schimp. — Berkshire (1, CUW, NEBC); Bristol (13, NEBC); Essex (FH, NEBC); Hampshire (EMD, MASS); Middlesex (10, 27, EMD, FH, NEBC); Nantucket (20); Norfolk (FH, WELC); Plymouth (NEBC); Worcester (WELC).

Pohlia annotina (Hedw.) Loesk. — Berkshire (3); Bristol (13, 21, NEBC); Essex (NEBC); Norfolk (NEBC); Worcester (EMD, FJH).

P. bulbifera (Warnst.) Warnst. — Essex (12).

P. cruda (Hedw.) Lindb. — Berkshire (3).

P. elongata Hedw. — Berkshire (1).

P. nutans (Hedw.) Lindb. — Berkshire (1, 16); Bristol (13, 21, NEBC); Essex (22, FH, NEBC, PM); Franklin (NEBC); Hampshire (EMD, FH, NEBC); Middlesex (10, EMD, FH, NEBC, WELC); Nantucket (20); Norfolk (11, FH, FJH, WELC); Plymouth (23, FH); Suffolk (11, FH, NEBC); Worcester (CUW, NEBC, WELC).

P. pulchella (Hedw.) Lindb. — Hampshire (15, FH); Middlesex (15, FH, NEBC); Norfolk (15, EMD, FH, NEBC); Suffolk (15, NEBC).

P. rothii (Corr.) Broth. — Berkshire (6, 12).

P. wahlenbergii (Web. & Mohr) Andrews — Bristol (21).

Rhodobryum roseum (Hedw.) Limpr. — Berkshire (1, 16, FH); Bristol (13, FJH); Essex (22, 23, FH, FJH); Franklin (FH); Hampshire (MASS); Middlesex (10, 23, 27, FH, FJH); Norfolk (11, CUW, FH, FJH, WELC); Suffolk (11, FJH); Worcester (CUW, EMD, NEBC).

MNIACEAE

Mnium affine Bland. — Berkshire (1, FH, NEBC); Bristol (13, 21, FH, NEBC); Essex (FH); Hampden (FH, NEBC); Middlesex (10, 27, EMD, NEBC, WELC); Nantucket (19, 20); Norfolk (11, NEBC); Plymouth (23, NEBC); Suffolk (11, 23, 28, NEBC); Worcester (CUW, MASS, NEBC, WELC).

M. cinclidioides Hueb. — Bristol (13, EMD, NEBC); Middlesex (EMD, FH, NEBC); Nantucket (20); Norfolk (CUW, NEBC, WELC); Worcester (CUW, EMD, FH, NEBC).

M. cuspidatum Hedw. — Berkshire (1, CUW); Bristol (13, 21, FH, NEBC); Dukes (WELC); Essex (22, 23, FH, NEBC, PM); Franklin (FH); Hampden (WELC); Hampshire (NEBC); Middlesex (10, 23, 27, EMD, FH, NEBC, WELC); Norfolk (11, FH, NEBC, WELC); Plymouth (23, NEBC); Suffolk (11, NEBC); Worcester (CUW, NEBC).

M. hornum Hedw. — Bristol (13, 21, FH, NEBC); Essex (22, 23, CUW, FH, NEBC, PM); Hampshire (MASS); Middlesex (10, 23, FH, NEBC); Nantucket (20); Norfolk (11, FH, NEBC); Plymouth (23, FH); Suffolk (11, 28, NEBC); Worcester (CUW, EMD, FH, NEBC, WELC).

M. orthorhynchum Brid. — Berkshire (6).

M. punctatum Hedw. — Berkshire (1, CUW, NEBC); Bristol (13, 21, NEBC); Essex (22, 23, NEBC, PM); Middlesex (NEBC, WELC); Nantucket (19); Norfolk (11, NEBC); Plymouth (23); Suffolk (11); Worcester (CUW, NEBC, WELC).

M. punctatum var. *elatum* Schimp. — Berkshire (1, CUW, WELC);

Hampshire (MASS); Middlesex (EMD); Plymouth (NEBC); Worcester (EMD).

M. serratum Brid. (*M. marginatum*) — Berkshire (1); Hampshire (NEBC); Middlesex (10, 23, FH, WELC); Plymouth (NEBC).

M. spinulosum B. S. G. — Berkshire (4, FH).

M. stellare Hedw. — Berkshire (1); Bristol (13); Middlesex (10, 27).

AULACOMNIACEAE

Aulacomnium androgynum (Hedw.) Schwaegr. — Barnstable (FH); Bristol (13, NEBC); Essex (22, PM); Middlesex (10, 23, NEBC); Plymouth (23).

A. heterostichum (Hedw.) B. S. G. — Berkshire (1); Bristol (13, FH, NEBC, WELC); Essex (22, FH, PM); Franklin (FH, NEBC); Hampden (FH); Middlesex (10, 27, EMD, FJH, NEBC, WELC); Norfolk (11, FH, NEBC, WELC); Plymouth (23); Suffolk (11, 23); Worcester (EMD, NEBC, WELC).

A. palustre (Hedw.) Schwaegr. — Barnstable (FH, NEBC); Berkshire (FH); Bristol (13, 21, FH, NEBC); Essex (22, FH, FJH, NEBC, PM); Hampden (FH); Middlesex (10, 23, 27, EMD, FH, FJH, NEBC); Nantucket (20, FH, FJH, NEBC); Norfolk (11, FH, FJH, NEBC); Plymouth (EMD, FH); Suffolk (11, FH, NEBC); Worcester (CUW, EMD, NEBC, WELC).

MEESIACEAE

Meesia longiseta Hedw. — Berkshire (16).

BARTRAMIACEAE

Bartramia pomiformis Hedw. — Berkshire (1, CUW, FH); Bristol (FH, NEBC); Essex (22, 23, FH, NEBC, PM); Franklin (MASS); Hampden (FH, WELC); Hampshire (EMD, MASS, NEBC); Middlesex (10, 11, 27, EMD, FH, NEBC); Norfolk (11, FH, FJH, NEBC, WELC); Suffolk (11); Worcester (CUW, FH, MASS, NEBC, WELC).

B. pomiformis var. *crispa* B. S. G. — Essex (23); Hampden (FH); Middlesex (FH); Plymouth (23).

Philonotis fontana (Hedw.) Brid. — Barnstable (FH); Berkshire (1); Bristol (13, 21, NEBC); Dukes (WELC); Essex (22, 23, NEBC, PM); Hampden (FH); Hampshire (MASS); Middlesex (10, 11, 27, EMD, FH, NEBC, WELC); Nantucket (20); Norfolk (11, EMD, FH, WELC); Suffolk (11, FH, NEBC); Worcester (CUW, FH, NEBC, WELC).

TIMMIACEAE

Timmia megapolitana Hedw. — Berkshire (16, NEBC); Hampshire (NEBC).

PTYCHOMITRIACEAE

Campylostelium saxicola (Web. & Mohr) B. S. G. — Bristol (13, FH, NEBC); Essex (FH, NEBC).

Ptychomitrium incurvum (Muhlenb.) Sull. — Bristol (13, NEBC); Middlesex (NEBC).

ORTHOTRICHACEAE

Amphidium lapponicum (Hedw.) Schimp. — Berkshire (6).

Drummondia prorepens (Hedw.) Jenn. — Berkshire (1); Bristol (13, NEBC); Essex (22, 23, NEBC, PM); Hampshire (MASS); Middlesex

(10, 23); Norfolk (11, CUW, FH, NEBC); Suffolk (FH); Worcester (NEBC, WELC).

Orthotrichum anomalum Hedw. — Bristol (13, NEBC); Essex (22, 23, PM).

O. lescurii Aust. — Essex (22); Suffolk (11).

O. obtusifolium Brid. — Berkshire (6, NEBC); Bristol (13); Middlesex (10, 27, FH, WELC); Suffolk (WELC).

O. ohioense Sull. & Lesq. — Norfolk (NEBC); Suffolk (NEBC); Worcester (NEBC).

O. pumilum Dicks. — Bristol (21).

O. pusillum Mitt. — Middlesex (10).

O. sordidum Sull. & Lesq. — Berkshire (WELC); Essex (EMD); Hampshire (FJH); Middlesex (10, EMD); Norfolk (11, FH, NEBC); Suffolk (11); Worcester (NEBC, WELC);

O. stellatum Brid. — Berkshire (NEBC); Essex (NEBC); Franklin (12).

O. strangulatum P. Beauv. — Berkshire (1); Bristol (13); Hampden (WELC); Hampshire (MASS); Middlesex (10, 27, EMD, NEBC); Norfolk (11, NEBC); Suffolk (11, 28, NEBC); Worcester (MASS).

Ulota crispa (Hedw.) Brid. — Berkshire (1, CUW); Bristol (13, NEBC); Essex (22, 23, FH); Middlesex (10, EMD, FH, WELC); Nantucket (20); Norfolk (11, CUW, FH, NEBC); Plymouth (23, WELC); Suffolk (11, NEBC); Worcester (FH, NEBC).

U. hutchinsiae (Sm.) Hammar (*U. americana*) — Berkshire (1, CUW, FH, NEBC); Bristol (13, 21, FH); Essex (22, 23, FH, NEBC, PM); Hampden (FH); Hampshire (NEBC); Middlesex (10, 11, 23, 27, EMD, FH, NEBC, WELC); Norfolk (11, CUW, FH, FJH, WELC); Plymouth (FH, NEBC, WELC); Suffolk (11, 28, FH, NEBC, WELC); Worcester (CUW, FH, MASS, NEBC, WELC).

U. ludwigii Brid. — Berkshire (1, CUW); Bristol (13, NEBC); Essex (FH); Norfolk (11, CUW); Suffolk (11); Worcester (NEBC).

FONTINALACEAE

Dichelyma capillaceum (Myr.) B. S. G. — Bristol (13, EMD, FH, NEBC); Essex (17, 22, FH, FJH, NEBC, PM); Middlesex (10, 27, EMD, FH, NEBC, WELC); Nantucket (20); Norfolk (CUW, FH, WELC); Plymouth (23, NEBC); Suffolk (NEBC); Worcester (25, CUW, FH, MASS, NEBC).

D. pallescens B. S. G. — Bristol (13, NEBC); Middlesex (10, FH); Nantucket (19); Plymouth (23); Suffolk (11, CUW).

Fontinalis antipyretica Hedw. — Berkshire (16); Middlesex (23, FH, NEBC); Nantucket (19); Plymouth (23).

F. antipyretica var. *gigantea* Sull. — Barnstable (EMD); Berkshire (FH); Bristol (13, FH, NEBC); Essex (22, FH, NEBC, PM); Hampshire (MASS); Middlesex (10, EMD, FH, NEBC, WELC); Norfolk (FH, NEBC, WELC); Plymouth (NEBC); Suffolk (11, NEBC); Worcester (25, FH, MASS).

F. dalecarlica B. S. G. — Berkshire (FH); Bristol (13, EMD, NEBC);

Essex (FH); Norfolk (EMD, FJH, WELC); Plymouth (23); Suffolk (EMD); Worcester (25, CUW, FH, MASS).

F. flaccida Ren. & Card. — Bristol (13, EMD, FJH); Worcester (EMD, FJH, NEBC).

F. lescurii Sull. — Bristol (13, EMD, NEBC); Essex (17, 22, NEBC, PM); Norfolk (EMD, FH); Suffolk (11, NEBC); Worcester (EMD, FJH).

F. novae-angliae Sull. — Berkshire (FH, NEBC); Bristol (13, 21, FH); Essex (22, FH, NEBC); Hampshire (MASS); Middlesex (EMD, FH, WELC); Nantucket (20); Norfolk (WELC); Suffolk (11); Worcester (25, EMD, FJH).

F. novae-angliae var. *latifolia* Card. — Essex (FH); Middlesex (FH); Norfolk (FH).

F. sullivanti Lindb. — Essex (NEBC, WELC); Norfolk (FH, NEBC); Worcester (25, FH).

CLIMACIACEAE

Climacium americanum Brid. — Berkshire (2, 16, FH, NEBC); Bristol (13, EMD, FH, NEBC); Essex (22, 23, EMD, FH, NEBC, PM); Hampden (FH, NEBC); Hampshire (MASS); Middlesex (10, 11, 23, 27, EMD, FH, NEBC, WELC); Norfolk (11, EMD, FH, FJH, NEBC, WELC); Plymouth (23); Suffolk (11, NEBC); Worcester (CUW, FH, MASS).

C. americanum var. *kindbergii* Ren. & Card. (*C. kindbergii*) — Bristol (21, FH); Essex (FH, NEBC, WELC); Hampden (NEBC); Middlesex (EMD, FH, NEBC); Nantucket (20); Norfolk (FH); Worcester (FH, WELC).

C. dendroides (Hedw.) Web. & Mohr — Berkshire (7); Bristol (13).

HEDWIGIACEAE

Hedwigia ciliata (Hedw.) P. Beauv. — Berkshire (1, 16, 23, CUW, NEBC); Bristol (13, 21, NEBC); Essex (22, 23, FH, NEBC, PM); Franklin (FH); Hampshire (CUW, MASS, NEBC); Middlesex (10, 11, 27, FH, NEBC); Norfolk (11, FH, FJH, NEBC, WELC); Suffolk (11, 28, NEBC); Worcester (CUW, FH, NEBC).

LEUCODONTACEAE

Forsstroemia trichomitria (Hedw.) Lindb. *(Leptodon trichomitrion)* — Berkshire (16, NEBC, WELC); Bristol (13, NEBC); Essex (EMD, NEBC, WELC); Middlesex (10, 27, NEBC).

Leucodon brachypus Brid. — Bristol (13); Essex (22, 23, FH); Middlesex (10, 23); Suffolk (WELC).

L. julaceus (Hedw.) Sull. — Bristol (13, FH); Norfolk (11); Suffolk (11).

L. sciuroides (Hedw.) Schwaegr. — Berkshire (1, CUW, EMD, FH, FJH); Essex (FH); Hampden (EMD, WELC); Middlesex (FH); Norfolk (FH).

NECKERACEAE

Homalia jamesii Schimp. — Berkshire (4, FH, NEBC); Worcester (NEBC).

Neckera complanata (Hedw.) Hueb. — Middlesex (10, 27).

N. pennata Hedw. — Berkshire (1, 16, NEBC, WELC); Bristol (13,

NEBC); Essex (22, 23, NEBC, PM); Middlesex (10, 27); Norfolk (NEBC); Plymouth (23); Worcester (23, MASS).

Porotrichum alleghaniense (C. Muell.) Grout — Berkshire (CUW, EMD, FJH, NEBC); Franklin (MASS); Hampshire (EMD); Middlesex (10, 11, FH, NEBC); Plymouth (23); Suffolk (11); Worcester (CUW, EMD, NEBC).

LEMBOPHYLLACEAE

Pseudisothecium myosuroides (Hedw.) Grout — Essex (15, FH, FJH, NEBC).

THELIACEAE

Myurella julacea (Schwaegr.) B. S. G. — Plymouth (23).

M. sibirica (C. Muell.) Reim. (*M. careyana*) — Berkshire (3, EMD, WELC); Franklin (MASS).

Thelia asprella Sull. — Bristol (13, FH, NEBC); Essex (22, NEBC, PM); Hampden (FH); Hampshire (MASS); Middlesex (10, 27, EMD, FH, NEBC); Norfolk (11, EMD, FH, NEBC, WELC); Suffolk (11); Worcester (CUW, EMD, FH, NEBC).

T. asprella var. *lescurii* (Sull.) Habeeb (*T. lescurii*) — Essex (22).

T. hirtella (Hedw.) Sull. — Barnstable (FH); Bristol (13, 21, EMD, FH, NEBC); Essex (22, FH, NEBC, PM); Middlesex (10, 27, FH, FJH, NEBC); Nantucket (20); Norfolk (11, EMD, FH, NEBC, WELC); Plymouth (FH); Suffolk (11, 28, FH, NEBC); Worcester (MASS, NEBC).

FABRONIACEAE

Anacamptodon splachnoides (Froehl.) Brid. — Berkshire (3); Franklin (NEBC); Middlesex (FH); Norfolk (EMD).

LESKEACEAE

Lescuraea patens (Lindb.) Arn. & C. Jens. (*Pseudoleskea patens*) — Bristol (13).

Leskea gracilescens Hedw. — Middlesex (23).

L. obscura Hedw. — Berkshire (CUW); Essex (22, EMD, FH, FJH, PM); Middlesex (FH); Norfolk (11, FH, WELC); Suffolk (11, NEBC); Worcester (CUW, EMD, FH, NEBC).

L. polycarpa Hedw. — Berkshire (CUW); Bristol (13); Essex (22, 23, EMD, FJH, PM); Hampden (FH); Hampshire (MASS); Middlesex (EMD, FH, NEBC, WELC); Worcester (CUW, EMD).

Leskeellea nervosa (Schwaegr.) Loesk. *(Leskea nervosa)* — Berkshire (4); Bristol (13).

THUIDIACEAE

Abietinella abietina (Hedw.) Fleisch. (*Thuidium abietinum*) — Berkshire (7).

Anomodon attenuatus (Hedw.) Hueb. — Berkshire (1, 7, EMD, NEBC); Bristol (13, 21, FH, NEBC); Essex (22, FH, NEBC, PM); Franklin (MASS); Hampden (WELC); Hampshire (MASS); Middlesex (10, 23, 27, FH, NEBC); Norfolk (11, FH, FJH, NEBC, WELC); Plymouth (NEBC); Suffolk (NEBC); Worcester (FH, NEBC).

A. minor (P. Beauv.) Lindb. — Essex (NEBC); Franklin (FH); Hampshire (MASS); Middlesex (10, 27, FH, NEBC); Norfolk (FH, NEBC).

A. rostratus (Hedw.) Schimp. — Berkshire (2, NEBC, WELC); Bristol (13, 21, EMD, FH, NEBC); Essex (22, FH, NEBC, PM); Franklin (MASS); Hampshire (MASS); Middlesex (10, EMD, FH); Norfolk (11, EMD, FH, FJH, NEBC, WELC); Plymouth (FH); Suffolk (11, NEBC); Worcester (FH).

A. rugelii (C. Muell.) Keissl. — Berkshire (1, NEBC, WELC); Bristol (13); Hampden (WELC).

Haplocladium virginianum (Hedw.) Broth. (*Thuidium virginianum*) — Bristol (15, NEBC); Middlesex (15, EMD, WELC); Norfolk (15, WELC); Suffolk (15, NEBC); Worcester (15, FH).

Haplohymenium triste (Ces.) Kindb. *(Anomodon tristis)* — Bristol (13, NEBC).

Helodium paludosum (Sull.) Aust. — Berkshire (3); Bristol (13, 21, EMD, FH); Essex (22, EMD, FH, NEBC, PM); Middlesex (10, FH, NEBC, WELC); Nantucket (20); Norfolk (EMD, FH, NEBC, WELC); Plymouth (FH); Suffolk (11, NEBC); Worcester (FH, NEBC).

Rauiella scita (P. Beauv.) Reim. (*Thuidium scitum*) — Berkshire (2); Bristol (13, FH); Essex (FH); Hampshire (MASS); Middlesex (10, FH); Norfolk (FH, WELC); Worcester (EMD).

Thuidium alleni Aust. — Bristol (13).

T. delicatulum (Hedw.) Mitt. — Barnstable (FH); Berkshire (1, 7, FH, NEBC, WELC); Bristol (13, 21, NEBC); Essex (22, FH, NEBC, PM); Franklin (FH, MASS); Hampden (NEBC); Hampshire (FH, MASS, NEBC); Middlesex (10, 27, EMD, FH, FJH, NEBC, WELC); Nantucket (20); Norfolk (11, FH, NEBC, WELC); Suffolk (11, NEBC); Worcester (CUW, EMD, FH, MASS, NEBC).

T. minutulum (Hedw.) B. S. G. — Berkshire (16); Bristol (13); Middlesex (FH); Norfolk (FH); Plymouth (23, NEBC).

T. recognitum (Hedw.) Lindb. — Barnstable (FH); Berkshire (FH); Essex (22, FH, NEBC, PM); Middlesex (FH); Norfolk (11); Suffolk (11, NEBC).

AMBLYSTEGIACEAE

Amblystegiella confervoides (Brid.) Loesk. — Berkshire (6).

A. subtilis (Hedw.) Loesk. — Berkshire (6); Franklin (FH); Hampshire (NEBC); Middlesex (FH); Norfolk (FJH, WELC); Suffolk (MASS).

Amblystegium juratzkanum Schimp. — Bristol (21); Essex (NEBC); Middlesex (EMD, FH, FJH, NEBC); Suffolk (NEBC).

A. serpens (Hedw.) B. S. G. — Berkshire (2, 16, NEBC); Bristol (13); Essex (22, FH, PM); Middlesex (10, 23, 27, EMD, FH, WELC); Norfolk (NEBC); Plymouth (NEBC); Suffolk (28, NEBC); Worcester (EMD, FH, NEBC).

A. varium (Hedw.) Lindb. — Berkshire (3, NEBC, WELC); Bristol (13, FJH); Essex (FH); Franklin (NEBC); Hampden (FH); Middlesex (FH, NEBC); Norfolk (FH, WELC); Suffolk (FH, NEBC); Worcester (FH).

Calliergon cordifolium (Hedw.) Kindb. — Bristol (13, 21, NEBC); Essex (22, FH, NEBC, PM); Middlesex (10, FH, NEBC, WELC); Nantucket

(20); Norfolk (11, FH, NEBC); Plymouth (23, FH); Suffolk (11, 23); Worcester (CUW, FH, NEBC).

Calliergonella cuspidata (Brid.) Loesk. — Berkshire (3); Bristol (13); Essex (NEBC, WELC); Franklin (MASS); Middlesex (27, NEBC, WELC); Worcester (NEBC).

Campylium chrysophyllum (Brid.) Bryhn — Berkshire (NEBC, WELC); Essex (22, CUW, NEBC, PM); Middlesex (10, 27, FH); Norfolk (FH, NEBC); Worcester (CUW, FH, NEBC).

C. hispidulum (Brid.) Mitt. — Berkshire (2, FJH, WELC); Bristol (13, FH); Essex (22, FH, NEBC); Hampshire (EMD, FJH); Middlesex (10, 27, EMD); Norfolk (FH, WELC); Suffolk (28, NEBC); Worcester (NEBC).

C. polygamum (B. S. G.) Bryhn — Barnstable (15, FJH, NEBC); Middlesex (15, EMD, FH).

C. radicale (P. Beauv.) Grout — Middlesex (FH, NEBC); Suffolk (11); Worcester (WELC).

C. stellatum (Hedw.) Lang. & C. Jens — Barnstable (12); Berkshire (4); Essex (22, NEBC, PM).

Cratoneuron filicinum (Hedw.) Roth — Berkshire (6).

Drepanocladus aduncus (Hedw.) Warnst. — Bristol (21); Essex (FH, NEBC, PM); Middlesex (10, 27, FH, FJH, NEBC); Worcester (25, CUW).

D. aduncus var. *kneiffii* (B. S. G.) Moenk. — Bristol (21); Middlesex (FH); Norfolk (FH); Worcester (WELC).

D. aduncus var. *polycarpus* (Bland.) Warnst. — Essex (NEBC); Nantucket (20).

D. exannulatus (B. S. G.) Warnst. — Bristol (13).

D. fluitans (Hedw.) Warnst. — Barnstable (FH, NEBC); Bristol (13); Essex (FH, NEBC, PM); Middlesex (10, 23, EMD, FH, FJH, NEBC); Nantucket (20); Norfolk (11, FH, NEBC, WELC); Suffolk (11); Worcester (CUW, EMD, NEBC, WELC).

D fluitans var. *falcatus* (B. S. G.) Roth — Nantucket (20); Worcester (CUW).

D. uncinatus (Hedw.) Warnst. — Berkshire (1); Bristol (13); Essex (FH, PM); Hampshire (EMD, FJH); Worcester (CUW, NEBC, WELC).

Hygroamblystegium fluviatile (Hedw.) Loesk. — Essex (15, FH, NEBC, PM); Middlesex (15, FH, NEBC); Norfolk (15, WELC); Plymouth (15, EMD); Suffolk (15, NEBC).

H. orthocladon (P. Beauv.) Loesk. — Bristol (13, EMD); Hampshire (MASS); Middlesex (10, 11, 27, FH, NEBC); Norfolk (FH); Suffolk (NEBC); Worcester (FJH, NEBC, WELC).

H. tenax (Hedw.) Jenn. (*H. irriguum*) — Berkshire (2); Bristol (13, EMD); Essex (FH, NEBC); Franklin (NEBC); Middlesex (10, EMD, FH, FJH); Norfolk (FH); Worcester (FH, NEBC, WELC).

Hygrohypnum dilatatum (Wils.) Loesk. — Berkshire (2).

H. eugyrium (B. S. G.) Loesk. — Berkshire (2, FH, NEBC); Hampshire (MASS).

H. luridum (Hedw.) Jenn. (*H. palustre*) — Norfolk (FH); Worcester (CUW).

H. montanum (Wils.) Broth. — Berkshire (4, CUW); Worcester (CUW).

H. ochraceum (Turn.) Loesk. — Berkshire (CUW, NEBC); Bristol (13); Hampshire (MASS); Middlesex (FH); Norfolk (NEBC); Worcester (EMD, FH, FJH, NEBC).

Leptodictyum riparium (Hedw.) Warnst. — Barnstable (FH); Berkshire (MASS); Bristol (13, 21); Essex (FH, NEBC); Hampden (FH); Middlesex (10, 23, EMD, FH, FJH, NEBC, WELC); Nantucket (20, NEBC); Norfolk (11, FH, NEBC); Plymouth (23); Suffolk (11, NEBC); Worcester (25, CUW, FH, NEBC, WELC).

L. trichopodium var. *kochii* (B. S. G.) Broth. — Essex (15, FH, NEBC); Middlesex (15, FH, NEBC, WELC); Worcester (15, EMD).

Platyhypnidium rusciforme (Hedw.) Fleisch. (*Eurhynchium rusciforme*) — Berkshire (2, CUW, FH, NEBC); Bristol (13, EMD); Essex (22, PM); Franklin (MASS); Hampshire (MASS, WELC); Middlesex (10, FH, NEBC); Norfolk (FH); Suffolk (11, NEBC, WELC); Worcester (CUW, NEBC, WELC).

Platylomella lescurii (Sull.) Andrews (*Sciaromium lescurii*) — Bristol (13); Essex (12, EMD, NEBC); Hampshire (MASS).

BRACHYTHECIACEAE

Brachythecium acutum (Mitt.) Sull. — Berkshire (NEBC); Essex (FH); Nantucket (20); Norfolk (WELC); Worcester (25, EMD, MASS).

B. campestre B. S. G. — Bristol (13, EMD); Essex (22, 23, PM); Middlesex (EMD, FH); Norfolk (FH).

B. digastrum C. Muell. & Kindb. — Bristol (13, FJH, NEBC, WELC); Worcester (WELC).

B. flagellare (Hedw.) Jenn. (*B. plumosum*) — Berkshire (3, FH); Bristol (13, 21); Essex (22, EMD, FH, PM); Hampshire (MASS); Middlesex (10, 27, EMD, FH, NEBC); Norfolk (11, FH, NEBC); Plymouth (NEBC, WELC); Suffolk (11, NEBC); Worcester (FH).

B. flexicaule Ren. & Card. — Berkshire (FH); Bristol (13, EMD, FH, FJH, NEBC); Middlesex (FH); Norfolk (FH).

B. oxycladon (Brid.) Jaeg. & Sauerb. — Berkshire (3, CUW, FJH, NEBC); Bristol (13, NEBC, WELC); Essex (22, PM); Middlesex (10, 27, EMD, FJH, NEBC); Norfolk (NEBC, WELC); Suffolk (11, NEBC); Worcester (CUW, NEBC).

B. populeum (Hedw.) B. S. G. — Berkshire (FH); Bristol (13); Essex (22, FH); Middlesex (10, 27, FH, NEBC); Norfolk (11); Suffolk (11, 28, NEBC).

B. reflexum (Stark.) B. S. G. — Berkshire (1); Bristol (13).

B. rivulare B. S. G. — Berkshire (3, CUW, FH, NEBC); Bristol (13); Essex (FH); Franklin (FH); Hampden (NEBC); Hampshire (FH); Middlesex (EMD, FH, NEBC, WELC); Norfolk (NEBC, WELC); Worcester (CUW, FJH, WELC).

B. rutabulum (Hedw.) B. S. G. — Berkshire (4, 16, CUW, NEBC);

Bristol (13); Essex (22, EMD, FH, NEBC, PM); Franklin (FH); Hampshire (FJH, MASS); Middlesex (10, 27, EMD, FH, FJH, WELC); Norfolk (11, FH, NEBC, WELC); Suffolk (11, 28, CUW, NEBC); Worcester (23, CUW, NEBC).

B. rutabulum var. *flavescens* (Brid.) B. S. G. — Bristol (13); Suffolk (12).

B. salebrosum (Web. & Mohr) B. S. G. — Berkshire (1, 16); Bristol (13);Essex (22, 23, EMD, FH, FJH); Middlesex (10, 27, EMD, NEBC, WELC); Norfolk (11, FH, FJH, WELC); Plymouth (23, FH); Suffolk (11, 28, NEBC); Worcester (CUW, EMD, MASS, NEBC).

B. starkei (Brid.) B. S. G. — Berkshire (1); Bristol (13); Essex (EMD, FH, FJH, NEBC); Nantucket (20); Worcester (CUW, NEBC).

B. velutinum (Hedw.) B. S. G. — Berkshire (CUW, FH, NEBC); Bristol (13); Essex (22, PM); Hampshire (FH); Middlesex (10, FH, NEBC); Norfolk (FH, WELC); Suffolk (CUW, NEBC); Worcester (FH, NEBC).

Bryhnia graminicolor (Brid.) Grout — Berkshire (3).

B. novae-angliae (Sull. & Lesq.) Grout — Berkshire (6, NEBC); Bristol (13, 21, WELC); Essex (22, FH, NEBC, PM); Franklin (MASS); Middlesex (10, 27, EMD, FH, NEBC); Nantucket (20); Norfolk (11, NEBC); Suffolk (11, NEBC); Worcester (FH).

Camptothecium nitens (Hedw.) Schimp. — Berkshire (NEBC); Bristol (13).

Chamberlainia acuminata (Hedw.) Grout — Berkshire (16); Bristol (13, FJH); Essex (22, PM); Middlesex (10, NEBC); Plymouth (23).

C. acuminata var. *rupincola* (Sull. & Lesq.) Grout — Bristol (13).

C. cyrtophylla (Kindb.) Grout — Bristol (13).

Cirriphyllum boscii (Schwaegr.) Grout — Berkshire (3); Bristol (13, 21, EMD, FH, FJH, NEBC, WELC); Essex (FH, NEBC); Hampshire (FH); Middlesex (10, 27, EMD, FH, NEBC); Nantucket (20); Norfolk (FH, NEBC, WELC); Plymouth (23); Suffolk (11, CUW, NEBC).

C. piliferum (Hedw.) Grout — Bristol (13).

Eurhynchium pulchellum (Hedw.) Jenn. (*E. strigosum*) — Berkshire (2, CUW); Bristol (13); Essex (22, NEBC, PM); Hampden (CUW); Middlesex (FH); Norfolk (11, FH); Plymouth (23); Suffolk (11, NEBC); Worcester (MASS).

E. pulchellum var. scabrisetum (Grout) Ketchl. (*E. strigosum* var. *scabrisetum*) — Dukes (12).

Homalotheciella subcapillata (Hedw.) Card. — Bristol (13, NEBC).

Oxyrrhynchium hians (Hedw.) Loesk. (*Eurhynchium hians*) — Bristol (13); Plymouth (23).

Rhynchostegium serrulatum (Hedw.) Jaeg. & Sauerb. (*Eurhynchium serrulatum*) — Berkshire (3, NEBC, WELC); Bristol (13, 21, FH); Essex (22, 23, FH, NEBC); Middlesex (10, 23, 27, EMD, FH, FJH, NEBC, WELC); Norfolk (11, CUW, FH, NEBC, WELC); Plymouth (23); Suffolk (11, NEBC); Worcester (CUW, NEBC, WELC).

ENTODONTACEAE

Entodon cladorrhizans (Hedw.) C. Muell. — Berkshire (2, CUW, FH, NEBC, WELC); Bristol (13, NEBC); Essex (22, 23, FH, PM); Hamp-

shire (FJH); Middlesex (10, 23, 27, FH, NEBC); Norfolk (FH, WELC); Plymouth (NEBC); Worcester (CUW, FH, NEBC, WELC).

E. compressus (Hedw.) C. Muell. — Essex (23); Plymouth (23).

E. seductrix (Hedw.) C. Muell. — Berkshire (2); Bristol (13, 21, NEBC); Middlesex (10, 23, 27, FH, NEBC); Norfolk (11, FH, WELC); Suffolk (11, 28, NEBC); Worcester (FH, WELC).

Pleurozium schreberi (Brid.) Mitt. (*Calliergonella schreberi*) — Berkshire (1, 7, CUW, FH, NEBC); Bristol (13, NEBC); Essex (22, 23, EMD, FH, PM); Hampshire (EMD, MASS); Middlesex (10, 11, 27, EMD, FH, NEBC); Norfolk (11, FH); Plymouth (23); Suffolk (11, FH, NEBC); Worcester (EMD, FJH, NEBC).

Pterygynandrum filiforme Hedw. — Berkshire (6); Essex (EMD, FH, NEBC); Middlesex (10, NEBC); Norfolk (CUW).

PLAGIOTHECIACEAE

Plagiothecium denticulatum (Hedw.) B. S. G. — Berkshire (1, 16, CUW, FH, NEBC); Bristol (13, 21, NEBC); Essex (FH, NEBC, PM); Franklin (FH); Hampden (MASS); Middlesex (10, 11, 27, FH, NEBC); Norfolk (EMD, FH, FJH, WELC); Plymouth (NEBC); Suffolk (FH, NEBC); Worcester (CUW, EMD, FH).

P. elegans (Hook.) Sull. — Bristol (13); Hampshire (FH); Middlesex (EMD, FH); Worcester (FH).

P. latebricola (Wils.) B. S. G. — Essex (17, FH, NEBC); Middlesex (FH); Norfolk (FH); Worcester (CUW, EMD).

P. micans (Sw.) Par. — Bristol (13).

P. micans var. *fulvum* (Hook. & Wils.) Par. — Bristol (13).

P. roeseanum (Hamp.) B. S. G. — Essex (15, NEBC, WELC); Franklin (15, EMD); Hampshire (15, EMD).

P. ruthei Limpr. — Worcester (12).

P. sylvaticum (Brid.) B. S. G. — Berkshire (2, CUW, EMD); Essex (22, NEBC, PM); Middlesex (10, NEBC, WELC); Nantucket (20); Norfolk (FH, WELC); Suffolk (NEBC).

P. turfaceum (Lindb.) Lindb. — Berkshire (1, FH, WELC); Essex (22, FH, NEBC, PM); Franklin (FH).

SEMATOPHYLLACEAE

Brotherella delicatula (Jam.) Fleisch. — Berkshire (15, NEBC).

B. recurvans (Michx.) Fleisch. — Berkshire (2, CUW, FH, NEBC, WELC); Bristol (13, FH, NEBC); Franklin (FH); Middlesex (FH, FJH); Norfolk (FH, NEBC, WELC); Worcester (CUW).

Heterophyllium haldanianum (Grev.) Roth — Berkshire (2, 7, 16, CUW, FH, NEBC, WELC); Bristol (13, 21, FH, NEBC); Dukes (WELC); Essex (22, FH, NEBC, PM); Franklin (MASS); Hampden (MASS); Hampshire (EMD); Middlesex (10, 27, EMD, FH, NEBC); Nantucket (20); Norfolk (11, FH, FJH, NEBC, WELC); Suffolk (11, CUW, NEBC); Worcester (CUW, EMD, FH, WELC).

Sematophyllum adnatum (Michx.) Britt. — Bristol (13).

S. carolinianum (C. Muell.) Britt. — Bristol (13).

HYPNACEAE

Ctenidium molluscum (Hedw.) Mitt. (*Hypnum molluscum*) — Berkshire (6); Bristol (13); Essex (FH, NEBC); Middlesex (10, 27, EMD); Norfolk (EMD, NEBC); Plymouth (23); Suffolk (NEBC); Worcester (FH).

Dolichotheca striatella (Brid.) Loesk. (*Plagiothecium striatellum*) — Berkshire (CUW, EMD, FH, NEBC); Bristol (13, 21, EMD, FH); Essex (22, FH, NEBC, PM); Franklin (MASS); Hampden (NEBC); Middlesex (10, 27, EMD, FH, NEBC); Nantucket (20); Norfolk (CUW, FJH, NEBC); Worcester (CUW, EMD, NEBC).

Homomallium adnatum (Hedw.) Broth. — Berkshire (2); Bristol (13); Essex (22, 23, FH, NEBC); Middlesex (NEBC, WELC); Norfolk (FH, NEBC, WELC); Plymouth (FH); Suffolk (11, 28, NEBC); Worcester (EMD, MASS, NEBC, WELC).

Hypnum cupressiforme Hedw. — Berkshire (2, 16, FJH); Bristol (13, 21); Essex (22, 23, EMD, FH, NEBC, PM, WELC); Middlesex (10, 23, 27, EMD, FH, NEBC); Nantucket (20); Norfolk (11, EMD, FH, WELC); Plymouth (23, FH); Suffolk (11, 28, NEBC).

H. cupressiforme var. *filiforme* Brid. — Essex (CUW, NEBC); Plymouth (23).

H. cupressiforme var. *resupinatum* (Wils.) Schimp. — Essex (22).

H. cupressiforme var. *subjulaceum* Mol. — Bristol (15, NEBC, WELC); Middlesex (15, FH).

H. curvifolium Hedw. — Berkshire (2, CUW); Bristol (13, NEBC); Essex (22, NEBC, PM); Hampden (FH, NEBC); Middlesex (FH, WELC); Norfolk (FH, NEBC, WELC); Plymouth (23, FH); Suffolk (CUW, WELC); Worcester (CUW, NEBC).

H. fertile Sendtn. — Berkshire (15, CUW); Bristol (15, EMD); Middlesex (15, WELC); Suffolk (15, NEBC).

H. imponens Hedw. — Barnstable (FH); Berkshire (2, 16, CUW, FH, NEBC, WELC); Bristol (13, 21, FH); Essex (22, 23, PM); Franklin (FH, MASS, NEBC); Middlesex (10, FH, FJH, NEBC, WELC); Norfolk (11, CUW, FH, NEBC, WELC); Plymouth (23, FH); Suffolk (NEBC); Worcester (CUW).

H. lindbergii Mitt. (*H. arcuatum*) — Barnstable (FH); Bristol (13); Essex (FH, NEBC); Middlesex (EMD, FH).

H. pratense Koch — Berkshire (1, EMD); Worcester (CUW).

H. reptile Michx. — Berkshire (2, CUW, FH, NEBC); Bristol (13, 21); Essex (22, FH, NEBC, PM); Franklin (FH, MASS); Hampshire (EMD, FJH, WELC); Middlesex (10, 27, EMD, FH, NEBC, WELC); Nantucket (20); Norfolk (EMD, FH, FJH, NEBC, WELC); Suffolk (11, 23, CUW, NEBC); Worcester (FJH, NEBC, WELC).

H. vaucheri Lesq. — Essex (15, NEBC).

Platygyrium repens (Brid.) B. S. G. — Bristol (13, 21, NEBC); Essex (NEBC); Hampden (FH); Hampshire (FJH); Middlesex (FH, NEBC); Norfolk (EMD); Worcester (EMD, FH);

Ptilium crista-castrensis (Hedw.) De Not. (*Hypnum crista-castrensis*) — Berkshire (1, 16, CUW, FH, NEBC, WELC); Bristol (13); Essex

(22, 23, FH, NEBC, PM); Franklin (FH); Hampden (NEBC, WELC); Hampshire (MASS); Middlesex (10, 27, NEBC); Norfolk (FH); Suffolk (11, NEBC); Worcester (23, CUW).

Pylaisia intricata (Hedw.) B. S. G. — Barnstable (FH); Berkshire (1, 3, 16); Bristol (13); Essex (22, 23, FH, PM); Hampshire (MASS); Middlesex (10, 23, 27, CUW, FH, WELC); Norfolk (11, FH); Plymouth (23); Suffolk (11); Worcester (CUW).

P. jamesii Sull. & Lesq. — Suffolk (12, FH).

P. polyantha B. S. G. — Plymouth (23).

P. selwynii Kindb. — Berkshire (NEBC); Bristol (13, NEBC); Essex (FH); Hampden (NEBC); Hampshire (FJH); Middlesex (FH, NEBC); Norfolk (NEBC); Plymouth (NEBC); Suffolk (NEBC); Worcester (FH, NEBC).

P. subdenticulata Schimp. — Bristol (13).

HYLOCOMIACEAE

Hylocomium brevirostre (P. Beauv.) B. S. G. — Berkshire (3, FH, NEBC); Bristol (13); Essex (22).

H. splendens (Hedw.) B. S. G. — Berkshire (1, 7, CUW, FH, NEBC, WELC); Bristol (13, FH, NEBC); Essex (22, 23, FH, PM); Hampden (FH, NEBC); Hampshire (EMD, MASS); Middlesex (10, 23, 27, FH, NEBC); Norfolk (11, FH, NEBC); Plymouth (23); Worcester (EMD, FH, FJH, NEBC, WELC).

H. umbratum (Hedw.) B. S. G. — Berkshire (2).

Rhytidiadelphus squarrosus (Hedw.) Warnst. — Bristol (13); Essex (17, NEBC); Worcester (EMD, NEBC).

R. triquetrus (Hedw.) Warnst. — Berkshire (1, 7, 16, CUW, NEBC, WELC); Bristol (13, NEBC); Essex (22, 23, FH, NEBC, PM); Franklin (MASS); Hampden (FH); Hampshire (MASS); Middlesex (10, 23, 27, EMD, NEBC, WELC); Norfolk (11, FH, WELC); Plymouth (23); Worcester (CUW).

BUXBAUMIACEAE

Buxbaumia aphylla Hedw. — Barnstable (23); Bristol (13, 21, NEBC); Dukes (NEBC); Essex (FH, NEBC, PM); Franklin (FH); Hampden (FH, NEBC); Middlesex (10, 27, EMD, FH, NEBC); Norfolk (11, CUW, FH, NEBC, WELC); Plymouth (23, FH, NEBC); Suffolk (11, NEBC); Worcester (CUW, FH, NEBC).

B. subcylindrica Grout — Berkshire (2).

Diphyscium foliosum (Hedw.) Mohr — Barnstable (23); Berkshire (1, FH, NEBC); Bristol (13, 21, EMD, NEBC); Essex (17, 22, 23, FH, NEBC, PM); Hampden (NEBC); Hampshire (23, MASS, NEBC); Middlesex (10, 27, EMD, FH, NEBC); Norfolk (11, FH, NEBC, WELC); Plymouth (23, NEBC); Suffolk (11, NEBC); Worcester (CUW, NEBC, WELC).

POLYTRICHACEAE

Atrichum angustatum (Brid.) B. S. G. — Berkshire (1, CUW); Bristol (13, 21, NEBC); Essex (22, 23, FH, NEBC, PM); Hampshire (CUW, NEBC); Middlesex (10, 23, 27, EMD, FH, NEBC, WELC); Norfolk (11, FH, FJH, NEBC, WELC); Plymouth (NEBC); Suffolk (11, 28, FH, NEBC); Worcester (MASS, NEBC, WELC).

A. crispum (Jam.) Sull. — Bristol (13); Dukes (WELC); Essex (17, CUW, NEBC); Hampshire (MASS); Middlesex (EMD, NEBC); Norfolk (FJH).

A. undulatum (Hedw.) P. Beauv. — Berkshire (1, FH, WELC); Bristol (13, 21, NEBC); Essex (NEBC, PM); Franklin (MASS); Hampden (FH); Hampshire (MASS); Middlesex (10, 23, FH, NEBC, WELC); Nantucket (20); Norfolk (11, FH, NEBC, WELC); Plymouth (23); Suffolk (11, FH, NEBC); Worcester (FH).

Pogonatum alpinum (Hedw.) Roehl. — Berkshire (1); Essex (17, FH).

P. capillare (Michx.) Brid. — Berkshire (2, 24, CUW, FH, FJH, NEBC).

P. pensilvanicum (Hedw.) Par. — Barnstable (NEBC); Berkshire (3, CUW, FH, NEBC); Bristol (13, 21, NEBC); Essex (22, 23, FH, NEBC); Franklin (MASS); Middlesex (10, 23, EMD, FH, NEBC); Nantucket (20); Norfolk (11, FH, NEBC, WELC); Plymouth (23); Suffolk (11, FH, NEBC); Worcester (EMD, FJH).

P. urnigerum (Hedw.) P. Beauv. — Berkshire (1, FH); Worcester (NEBC).

Polytrichum commune Hedw. — Barnstable (FH); Berkshire (1, CUW); Bristol (13, 21, NEBC); Essex (22, 23, EMD, FH, NEBC, PM); Franklin (MASS); Hampden (FH); Middlesex (10, 11, 27, EMD, FH, NEBC); Nantucket (20); Norfolk (11, FH, NEBC, WELC); Plymouth (FH); Suffolk (11, 28, FH, NEBC); Worcester (CUW, EMD, FH, FJH, MASS).

P. commune var. *perigoniale* (Michx.) B. S. G. — Barnstable (NEBC); Berkshire (16, FH); Bristol (FH, NEBC); Middlesex (EMD, FH, NEBC); Norfolk (EMD, FH, WELC); Suffolk (NEBC); Worcester (FH, NEBC, WELC).

P. formosum Hedw. — Bristol (13); Middlsex (10, 27).

P. gracile Sm. — Bristol (13); Essex (22, 23); Middlesex (FH); Worcester (EMD, FH, NEBC).

P. juniperinum Hedw. — Berkshire (1, 16, CUW); Bristol (13, NEBC); Essex (22, FH, PM); Franklin (FH, NEBC); Hampden (NEBC); Middlesex (10, FH, NEBC); Norfolk (11, FH, FJH, NEBC, WELC); Plymouth (NEBC); Suffolk (11, 28, NEBC); Worcester (CUW, MASS).

P. juniperinum var. *alpestre* B. S. G. — Berkshire (NEBC); Bristol (13); Middlesex (EMD, FH); Nantucket (20); Norfolk (FH).

P. ohioense Ren. & Card. — Berkshire (1, CUW, FH, NEBC); Bristol (13, NEBC); Essex (FH, NEBC); Middlesex (EMD, FH, NEBC); Norfolk (11, FH, FJH, WELC); Plymouth (FH); Suffolk (11, NEBC); Worcester (CUW, FH, MASS).

P. piliferum Hedw. — Barnstable (FH, NEBC); Berkshire (1); Bristol (13, 21, FH, NEBC); Essex (22, 23, FH, NEBC, PM); Hampshire (EMD, MASS); Middlesex (10, 27, EMD, FH, FJH, NEBC); Nantucket (20); Norfolk (11, FH); Plymouth (NEBC); Suffolk (11, NEBC); Worcester (MASS, NEBC).

Names of Doubtful Application

The species listed below have been reported for Massachusetts or just outside of the state's boundries. In addition to their lack of precise location, many of these reports suffer from incorrect determination or errors in the application of names, as many represent taxa not found in America or at least not occurring in or near the New England area. The genera and species are arranged alphabetically.

Anomodon viticulosus (Hedw.) Hook. & Tayl. — Location uncertain. (9, 16).

Barbula fallax Hedw. — Location uncertain (9, 26).

Brachelyma subulatum (P. Beauv.) Card. — Middlesex (23); Plymouth (13).

Bryum turbinatum (Hedw.) Schwaegr. — Location uncertain. (16).

Calliergon stramineum (Brid.) Kindb. — Location uncertain. (26).

Camptothecium lutescens (Huds.) Bruch & Schimp. — Location uncertain. (16).

Dichelyma falcatum (Hedw.) Myr. — Location uncertain. (9, 26).

Dichodontium pellucidum (Hedw.) Schimp. — Location uncertain. (9, 26).

Dicranum strictum Schleich. — Essex (23); Plymouth (23).

Entosthodon fascicularis (Dicks.) C. Muell. — Middlesex (23).

Eurhynchium praelongum (Hedw.) Bruch & Schimp. — Location uncertain. (16).

E. striatum (Schreb.) Schimp. — Location uncertain. (16).

Fontinalis biformis Sull. — Location uncertain. (9, 26).

F. disticha Hook. & Wils. — Location uncertain. (9, 26).

F. lescurii var. *ramosior* Sull. — Location uncertain. (26).

Grimmia pulvinata (Hedw.) Sm. — Middlesex (23).

Haplocladium microphyllum (Hedw.) Broth. (*Thuidium microphyllum*) — Location uncertain. (16, 26).

Helodium blandowii (Web. & Mohr) Warnst. — Location uncertain. (9).

Isothecium myurum (Poll.) Brid. — Franklin (16).

Kiaeria falcata (Hedw.) Hag. (*Arctoa falcata*) — Suffolk (23).

Leptodictyum sipho (P. Beauv.) Broth. — Plymouth (23).

Mnium longirostrum Brid. — Location uncertain. (26).

Oncophorus polycarpus (Hedw.) Brid. — Location uncertain. (16).

Orthotrichum speciosum Nees — Location uncertain. (16).

O. striatum Hedw. — Middlesex (10).

Philonotis muhlenbergii (Schwaegr.) Brid. — Location uncertain. (26).

Plagiopus oederi (Brid.) Limpr. — Location uncertain. (16).

Plagiothecium undulatum (Hedw.) B. S. G. — Suffolk (23).

Pogonatum aloides (Hedw.) P. Beauv. — Berkshire (16).

P. brachyphyllum (Richs.) P. Beauv. — Berkshire (16).
Pohlia atropurpurea (Wahlenb.) Lindb. f. — Bristol (13).
Pottia lanceolata (Hedw.) C. Muell. — Berkshire (23).
Pseudoleskea catenulata (Brid.) B. S. G. — Essex (23).
Rhacomitrium ellipticum (Turn.) B. S. G. — Location uncertain. (26).
Rhynchostegium murale (Neck.) B. S. G. — Plymouth (23).
Thuidium tamariscinum (Hedw.) B. S. G. — Middlesex (27).
Tortula mucronifolia Schwaegr. — Location uncertain. (9, 26).
Ulota drummondii (Hook. & Grev.) Brid. — Location uncertain. (16).

It is hoped that the work outlined in this publication will stimulate latent interest in the taxonomy of mosses within Massachusetts. By using counties as basic geographical working units, clearly delimited areas which need considerable study have been indicated, and, by doing concentrated field work in these regions, it should be possible to close many of the glaring gaps in our knowledge of moss distribution. Furthermore, many local amateurs are intensely interested in the flora of their own counties and will work with great enthusiasm on "home territory." Only by using the talents and energy of both professional and amateur botanists, will our knowledge of the biogeography of Massachusetts be increased.

ACKNOWLEDGEMENTS

The author wishes to thank the following directors and staff members of the herbaria listed in this publication who made collections and facilities available to him: Burton N. Gates, I. MacKenzie Lamb, Maila E. Lamb, Gladys Miner, David Potter, Richard C. Potter, Emanuel D. Rudolph, and Dorothy Snyder. Especially does he acknowledge the assistance, advice, and many kindnesses of A. LeRoy Andrews, Henry S. Conard, Howard Crum, Elizabeth M. Dunham, Edwin H. Ketchledge, Paul Huffington, James Kucyniak, Clement C. Maxwell, Reed C. Rollins, Aaron J. Sharp, Otto T. Solbrig, Richard T. Wareham, and Carroll E. Wood.

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LATE NEGATIVE GEOTROPISM IN CHELONE. — During a recent fall collecting trip in Adair County, Kentucky, several unusual specimens of *Chelone obliqua* L. were discovered in alluvial soil in a damp woodland in an area of low light intensity. Eight mature plants (deposited in the herbarium of Chicago Natural History Museum) growing within a radius of about 10 feet exhibited the same unique growth form, in that all stems, which had bent over as if in response to the weight of the terminal seed pods, in every case had again bent upward at a sharp angle about 2 inches from the terminus. On three plants the point of this sharp upward bend was 6 to 8 inches above the soil surface. Five taller plants which had fallen over enough to touch the soil had formed adventitious roots from the under side of the area of curvature. One immature plant which had fallen over was also bent upward at about ½ inch from the terminus, but had formed no roots.

Chelone is known to be a proto-hemicryptophyte, a semi-rosette form capable of producing runners. To my knowledeg, neither propagation occurring by rooting from the stem nor such marked phototropism has previously been reported.

If the turning upward is a correlation phenomenon as the result of auxin induced formation of new roots, the interesting fact is that the negative geotropism takes place *before* the adventitious roots form. It is therefore suggested that *Chelone* would be a good selection for growth studies in the laboratory and in the field. — DOROTHY GIBSON, CHICAGO NATURAL HISTORY MUSEUM.

A NEW LOCALITY FOR ORCHIS ROTUNDIFOLIA VAR. LINEATA. — Dr. A. E. Porsild, National Museum of Canada, in 1939, received from Mr. W. C. McCalla, Calgary, Alberta, a photograph of an *Orchis rotundifolia* Banks, which differed from the typical plant in having broad, longitudinal, purple stripes instead of the usual purple dots on the lower lip. Specimens were not available for study at the time, but later the Museum received five specimens which had been collected by Mr. McCalla June 27, 1932 in damp mossy woods at Elkwater Lake, Cypress Hills, Alberta. In 1941, Mr. Henry Mousley[1] described the variety in detail and applied the name *O. rotundifolia* var. *lineata*. Isotypes were retained by Mr. McCalla and one was also placed in the Gray Herbarium. As far as can be determined no other localities have been reported for this variety.

During the summer of 1959, the writer was park naturalist for the Ontario Department of Lands and Forests in Sibley Park, a small peninsula projecting from the north shore of Lake Superior just east of Port Arthur. Here, on July 6, 1959, in a habitat similar to that described by Mr. McCalla, was found the variety *lineata*. About 100 plants were seen in an area of 300 square yards growing among *Habenaria hyperborea*, *H. obtusata*, *Listera cordata*, *Empetrum nigrum*, *Kalmia polifolia*, *Gaultheria hispidula*, and *Andromeda glaucophylla*. A thorough search was made for other stands, but none was found.

This is the first record of variety *lineata* within the range of Gray's Manual. Specimens from this station have been placed in the herbarium of the Ontario Agricultural College, Guelph, Ontario, and in the Gray Herbarium, Harvard University. — VINCENT ELLIOTT, SCIENCE DEPARTMENT, DISTRICT HIGH SCHOOL, WHITBY, ONTARIO.

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1 MOUSLEY, HENRY, A distinctive new variety of *Orchis rotundifolia* from Canada, *Orchis rotundifolia*, Banks N. var. *lineata*. Can. Field Nat. 40: 64-65. 1941.

Volume 62, No. 737, including pages 117-144, was issued June 22, 1960.

JUL 25 1960

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Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

REED CLARK ROLLINS, Editor-in-Chief

ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
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Vol. 62 July, 1960 No. 739

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

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Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Avenue, Cambridge 38, Mass.

Subscriptions and orders for back issues (making all remittances payable to RHODORA) should be sent to Albert F. Hill, Botanical Museum, Oxford Street, Cambridge 38, Mass.

Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

Rhodora

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NEW ENGLAND BOTANICAL CLUB

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VASCULAR PLANTS ON THE CINDER CONE OF PARICUTIN VOLCANO IN 1958

JOHN H. BEAMAN

The birth of Parícutin Volcano in a cornfield in the state of Michoacán, Mexico, in 1943 has provided an unparalleled opportunity for the study of volcanism and its effects. The eruption immediately attracted the attention of geologists, whereas biological phenomena were given relatively little consideration in the early years of the Volcano. Geological interest has subsided since the eruptive phase ended on March 4, 1952, but problems for the biologist are becoming increasingly evident. During the active period botanical studies were focused mostly at the destructive nature of the volcanic ejecta (Eggler, 1948, 1959) and the manner of preservation of a potential fossil record in the lava and ash (Dorf, 1945, 1951). The colonization by plants and animals of the wholly inorganic deposits of Parícutin now deserves a thorough, long-term scrutiny.

In the summer of 1958, while in Mexico for a study of the alpine flora in that country, I had the opportunity to make a side trip to Parícutin. The primary motive of this visit was to determine whether or not the same pioneer plant species might be involved in primary succession on volcanic deposits of a new volcano as are found in the alpine flora on the older and much larger volcanoes. In addition to age and size distinctions between Parícutin and the mountains with alpine vegetation, there is also a considerable difference in elevation. The cone of Parícutin has a maximum elevation of about 2800 meters, while the lower limit of the alpine flora is mostly above 3900 meters elevation. No species common

to the two areas were found, but the unexpected result of this visit was the discovery that 14 species of vascular plants already had gained a foothold on the cinder cone of Parícutin only six and a half years after volcanic activity had ceased.

For several reasons it appeared that the limited time available for this study could best be spent on the cinder cone. The lava flows, covering nearly 25 square kilometers (Fries and Gutiérrez, 1954), would be very difficult to examine critically in a short while, and much of the pyroclastic ejecta extend for hundreds of kilometers with no well-defined limits. The cone is the most prominent feature of the Volcano, and its age and history are thoroughly documented. It is small enough to allow observations that can be repeated from time to time by independent investigators. Although small, the cone provides a rather wide diversity of habitats. This report is thus concerned with the vascular plant species which are beginning to establish themselves on the cone of Parícutin.

GEOGRAPHY AND GEOLOGY

Parícutin Volcano is located in central western Michoacán approximately 30 kilometers WNW of Uruapan. Two former villages, Parícutin and San Juan Parangaricutiro, were buried by lava early in the life of the Volcano, and now the closest settlement is Angahuan about seven kilometers to the ENE. Parícutin lies in the zone of hundreds of volcanoes which crosses Mexico from east to west between the parallels of 18° and 22° N. latitude. It is situated about 10 kilometers north, on the lower slope, of the long extinct Cerros de Tancítaro which rises to an elevation of 3860 meters. In a report on the volcanoes of the Parícutin region, Williams (1950) indicated that more than 150 cinder cones and over 20 large lava cones were present in the area covered by his geological reconnaissance map (about 50 x 60 kilometers). In contrast to the massive Cerros de Tancítaro, most of the volcanoes in the region are about the same size as Parícutin. The most distinctive features of Parícutin are its youth and well-known geological history. The series of biological events now in action there must have previously taken place in a similar fashion on all of the other volcanoes.

From the original vent in the cornfield at an elevation of about 2400 meters, the cinder cone of Parícutin grew to a height of 10 to 12 meters in one day. In six days it was 167 meters high with a basal diameter of 730 meters and a crater diameter of 90 meters. Within 25 days the cone was about 200 meters high, and nine months after birth its present dimensions had nearly been attained (Foshag and Gonzáles R., 1956). Subsequent growth was much slower because of the large area over which ejected material was spread, and

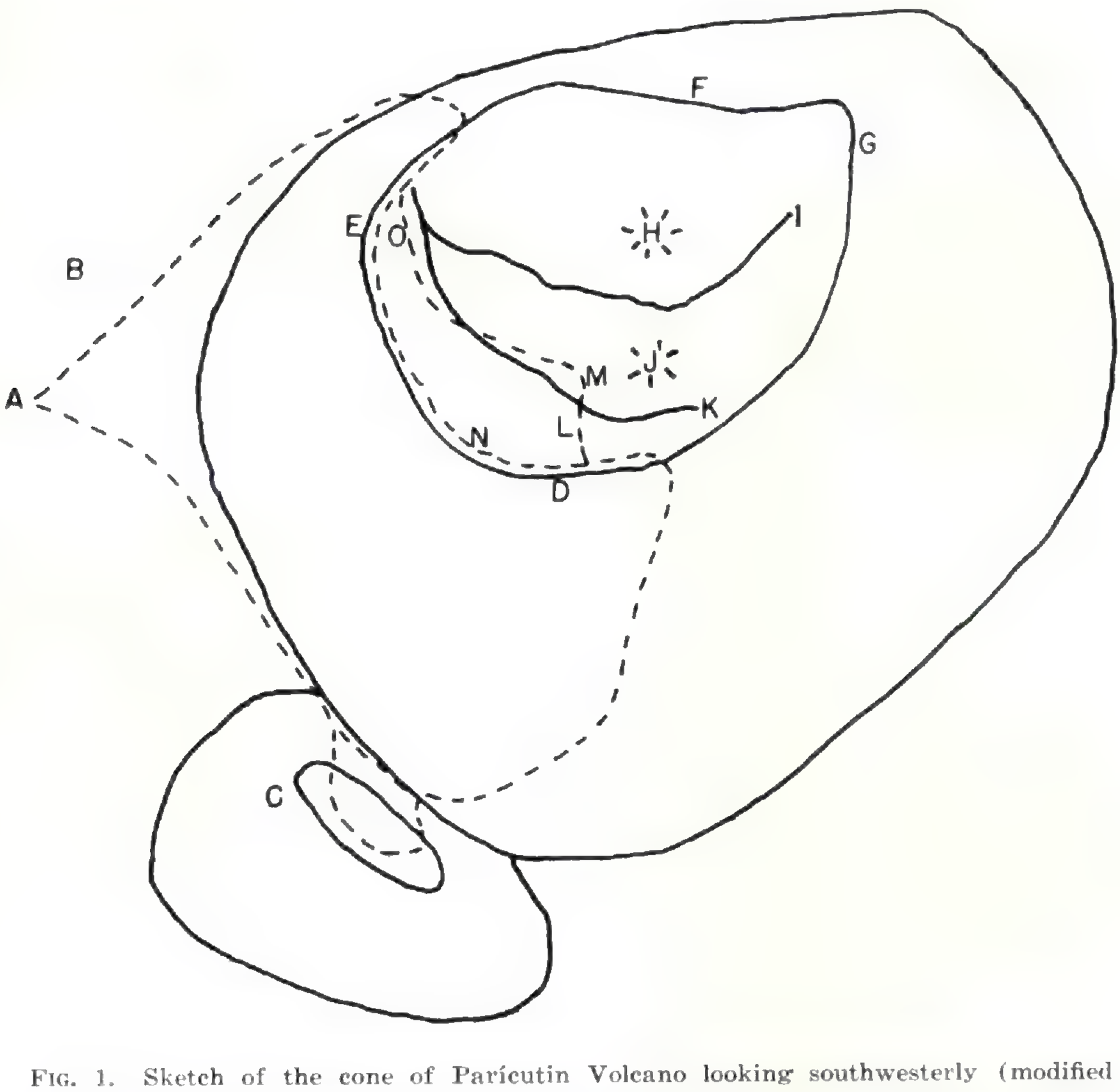

FIG. 1. Sketch of the cone of Parícutin Volcano looking southwesterly (modified from an oblique aerial photograph in Fries and Gutiérrez, 1954). A, route taken on cone; B, east base of cone; C, Nueva Juatita lava-vent mound; D, northeast saddle on rim of cone; E, east peak of rim; F, southwest saddle of rim; G, west peak of rim; H, southwest crater vent; I, ridge between crater vents; J, northeast crater vent; K, slump line; L, collection locality of *Pityrogramma calomelanos, P. tartarea, Pteridium aquilinum* var. *feei,* and undetermined fern; M, collection locality of *Pinus montezumae ?* ; N, collection locality of undetermined dicot seedling; O, collection locality of *Pellaea ternifolia* var. *ternifolia, Aegopogon cenchroides, Buddleia cordata, Aster exilis, Conyza coronopifolia, Eupatorium pazcuarense ?* , *Gnaphalium attenuatum,* and *G. semiamplexicaule.*

the increment from later ejecta was about balanced by erosion and slumping. Although the nearly final size of the cone was developed in a very short time, the exact morphology was not stabilized until activity ceased (Fries and Gutiérrez, 1954). Slumping of the sides occurred several times as a result of the flowing out of lava beneath. After slumps the cone sides were rebuilt by the ejection of pyroclastic material from the crater vents.

The dimensions of the cone on May 1, 1952 (three months after activity ceased) from measurements made by Fries and Gutiérrez (1954) are as follows: West peak, 2808.6 m. elevation; east peak, 2807.9 m. elevation; lowest point on the northeast rim, 2770.3 m. elevation; peaks of crater rim about 410 meters above original level of cornfield; base of cone oval with northeast-southwest diameter of about 650 meters and northwest-southeast diameter of 900 meters; crater rim nearly round with diameter of about 280 meters; bottoms of the two crater vents, aligned on northeast-southwest axis, about 30 or 40 meters below levels of northeast and southwest saddles on rim. The actual projection of the cone above its base is considerably greater than its apparent elevations because the lava flows immediately surrounding the cone are exceedingly thick. The Nueva Juatita lava-vent mound on the northeast side of the cone is only 79 meters below the lowest point on the rim of the crater. Although slumping, settling, and erosion have occurred since the 1952 measurements, the present dimensions of the cone probably are still very nearly equivalent. While the Volcano was still active the inclination of the outer slope of the cone ranged between 31° and 33° (Segerstrom, 1950).

Most of the cone is made up of successive layers of pyroclastic materials such as ash, cinders, lapillae, and bombs. Much of the upper crater surface is comprised of coarse to fine lapillae. The rim is mostly of fine cinders and ash with some larger fragments. The outer slope is of rather coarse rubble mixed with finer fragments. Segerstrom (1950) suggested that the base may contain some massive lava which does not extend very far up in the cone. According to Wilcox (1954) the petrographic character of the ejecta changed during the nine-year eruptive period from an olivine-bearing

basaltic andesite containing 55 percent silica to an orthopyroxene-bearing andesite containing over 60 percent silica. Williams (1950) indicated that the pyroclastic ejecta were identical with the lavas or differed only in having a higher glass content or a greater degree of vesicularity. At the end of activity in 1952, white crusts of ammonium chloride, deposited by exuding vapors, were conspicuous on the crater sides (Fries and Gutiérrez, 1954). Some of this material was still evident at the time of my visit in 1958, and gases were still being emitted by numerous fumerolic vents on both the cone and surrounding lava flows.

CLIMATE

The climate at Parícutin is temperate with a relatively cool, wet season from June to October and a cool, dry season from November to May. There are no climatic records for the area before the appearance of the Volcano, and the data are still inadequate. From rainfall records kept at two stations during most of the active period (cf. Fries and Gutiérrez, 1954) it can be seen that the annual precipitation varied from about 1300 to 2400 mm. Frosts and freezing temperatures occur during the winter months, but winter temperatures were reputedly milder during the eruptive period (Segerstrom, 1950).

PLANTS PREVIOUSLY REPORTED ON THE CONE

The first report of plants invading the cinder cone of Parícutin is by Eggler (1959) who indicated that in February of 1957 Mr. Kenneth Segerstrom of the U. S. Geological Survey found lichens and two species of angiosperms, probably a *Gnaphalium* and an *Eryngium*, growing on the rim of the crater. The *Gnaphalium* found by Segerstrom is very likely one of the two species of that genus obtained in the present study. Although no *Eryngium* was seen on the cone in this investigation, a specimen of *Eryngium beechyanum (Beaman 2399)* in full flower was found in volcanic ash at the edge of a deep gully about two kilometers east of the cone.

SPECIES FOUND IN 1958

The 14 vascular species found on the cone of Parícutin on September 1, 1958 are arranged by families below. Notes on habitats and certain other features of the plants are included. The route taken on the cone and the approximate

location of plants collected are shown in fig. 1. Voucher specimens are filed in the Herbarium of Michigan State University[1].

POLYPODIACEAE.

Pellaea ternifolia (Cav.) Link var. **ternifolia.** *(Beaman 2409)*. Only two small plants, growing in volcanic ash kept moist by gases from a fumerolic vent, were found near the summit of the east rim of the crater. The smaller of the two specimens has numerous sporangia on the pinnae of some fronds.

Pityrogramma calomelanos (L.) Link. *(Beaman 2408C)*. In the field this species was not distinguished from *P. tartarea*, and the two were inadvertently mixed in the collection. Either one or both species are common on the northeastern side of the crater among moderately coarse lapillae. These specimens are without sporangia.

Pityrogramma tartarea (Cav.) Maxon. *(Beaman 2408A)*. See discussion under *P. calomelanos*. One plant of this collection, with a single frond, has young sporangia. Other specimens in the collection are sterile. A specimen of the same species obtained from the lava at the east base of the cone was much larger and had several well-developed fertile fronds. Both Eggler (1959) and Clausen (1959) have noted that this is a pioneer species on Parícutin lava flows.

Pteridium aquilinum (L.) Kuhn var. **feei** (Fee) Maxon. *(Beaman 2408B)*. This species occurs with *Pityrogramma calomelanos* and *P. tartarea* on the sides of the crater. Two juvenile, sterile specimens were collected. Eggler (1948, 1959) and Clausen (1959) have noted that this is a common species in the Parícutin area.

Undetermined juvenile fern. *(Beaman 2408D)*. The single sterile plant obtained, growing with *Pityrogramma calomelanos*, *P. tartarea*, and *Pteridium aquilinum* var. *feei*, is too immature to permit more than a guess as to its identity.

PINACEAE.

Pinus montezumae Lamb. ? *(Beaman 2410)*. This seedling pine was growing about 10 meters below the northeast saddle

[1]I am indebted to Dr. Rolla Tryon for determinations of the ferns and to Dr. Rogers McVaugh for recognizing the sterile specimens of *Aster exilis*, and for suggestions that lead to the determination of another species. My able native guide for the trip to the cone was Sr. José Cruz Gomez of Angahuan, Michoacán. A grant from the Penrose Fund of the American Philosophical Society made possible the field study in Mexico.

on the side of the crater. Only a single specimen was found. The substrate was of rather coarse lapillae, and no fumerolic vents were noted in the near vicinity. *Pinus montezumae* is one of the most important forest components around Parícutin, and this plant is very similar to a mature specimen *(Beaman 2412)* collected near by. The only other common species of pine observed in the area is *P. leiophylla (Beaman 2422)*, and the seedling is definitely not that species. At least three other species *(P. pseudostrobus, P. michoacana,* and *P. teocote,* cf. Martinez, 1948) probably occur in the Parícutin region, but the seedling is more like *P. montezumae* than any of these. The specimen has secondary fascicles with only three and four needles (the species is typically five-needled), but variations above and below the usual number were found in other seedlings in the area. The plant was in at least its second season as indicated by the presence of both old, solitary primary leaves and younger secondary leaves.

GRAMINEAE.

Aegopogon cenchroides H. & B. *(Beaman 2411)*. Two small plants of this species, one with a slightly developed inflorescence, were found in volcanic ash kept moist by gases from a fumerolic vent near the summit of the east rim of the crater. A much more vigorous plant of the species *(Beaman 2390)*, already with several well-developed stolons, was found among lava boulders at the east base of the cone. This species was not observed in ash deposits that were examined several kilometers away from the cone, but the superficially similar species, *Cynodon dactylon*, was found to be an important pioneer in the ash.

LOGANIACEAE.

Buddleia cordata HBK. *(Beaman 2406)*. A single seedling plant was obtained near the summit of the east rim of the crater in volcanic ash kept moist by gases from a fumerolic vent. Several larger plants of the same species *(Beaman 2396)* were scattered on the lava at the east base of the cone. *Buddleia cordata* is a common species in the Mexican volcanic highlands.

COMPOSITAE.

Aster exilis Ell. *(Beaman 2405)*. This was the most abundant species in the moist volcanic ash by a fumerolic vent

near the summit of the east rim of the crater. None of the specimens had begun to flower, but other herbarium specimens of this common *Aster* closely match this collection.

Conyza coronopifolia HBK. *(Beaman 2407)*. Three small plants, two in flower, were found in the same area with *Aster exilis*. *Conyza coronopifolia* is a common weedy species in the Mexican volcanic highlands.

Eupatorium pazcuarense HBK. ? *(Beaman 2403)*. Five sterile plants of this species were found near the summit of the east rim of the crater in moist volcanic ash near a fumerolic vent. Several species of *Eupatorium* in this complex are very similar vegetatively, thus making determination difficult. A few larger plants *(Beaman 2393)* with dried flowering stems of the previous season still attached were found on moist lava cliffs at the east base of the cone. These closely resemble other herbarium specimens of *E. pazcuarense* from Michoacán.

Gnaphalium attenuatum DC. *(Beaman 2404)*. Four plants, one beginning to flower, were collected in the vicinity of a fumerolic vent near the eastern summit of the rim of the crater. Two specimens with abundant inflorescences *(Beaman 2394)* were found on lava at the east base of the cone.

Gnaphalium semiamplexicaule DC. *(Beaman 2412)*. Two specimens, one a rosette and the other at a slightly older stage, were obtained from the area near the summit of the east rim of the crater. Four other specimens *(Beaman 2392)* in bud and flower, were found on lava at the east base of the cone.

FAMILY UNDETERMINED.

Undetermined dicot seedling. *(Beaman 2402)*. This single plant was growing on the saddle of the northeast rim of the crater. No other plants were observed in the immediate area, but the pine seedling and the ferns (except *Pellaea ternifolia* var. *ternifolia)* were collected on the side of the crater not far below this point on the rim.

DISCUSSION

An extensive survey of the flora of the Parícutin region has not been published, but a floristic study of the south side

of the neighboring Cerros de Tancítaro was made by Leavenworth (1946). At comparable elevations many species are common to these two areas, but only six of the 14 species found on the cone of Parícutin were also collected by Leavenworth. Observations on the vegetation in the vicinity of Parícutin were made by Eggler (1948, 1959) and Clausen (1959), but their interests were not primarily floristic. Only two of the species *(Pityrogramma tartarea* and *Pteridium aquilinum)* which Eggler (1959) noted for their ability to survive or reproduce in the volcanically affected soils were found on the cone in this study. I made some effort to locate in near by areas the same species that were collected on the cinder cone. This attempt was most successful on the lava flows adjacent to the cone where six of the same species were found. A thorough study of the flora of the Parícutin region is still needed to give some measure of the overall importance of species as they colonize the barren volcanic deposits.

It seems highly probable that all of the species on the cone were carried there as wind-borne propagules, although dispersal by animals, especially birds, cannot be entirely discounted. The Polypodiaceae and the Compositae, both with five species, are predominant in the cone flora, while the other three determined species belong to different families. The small size of the fern spores makes them well adapted to wind transport. All of the Compositae found on the cone are species with a well-developed pappus. The winged seeds of the pine make wind dispersal also the likely method of its transport. *Aegopogon cenchroides* has small, light spikelets with several awns which would serve in wind dispersal about as effectively as the pappus of the composites. The *Buddleia* species has very small seeds which could be blown by wind for a considerable distance.

Soil conditions, in contrast to those in which the species ordinarily occur, must be extremely inorganic on the cone. Organic products would be present only through the biological actions of the earliest pioneer species or by being transported there from surrounding areas. These sources must have already contributed some organic materials, but the

cone substrates probably have not yet been significantly altered. In the studies of Katmai Volcano in Alaska, Griggs (1919) noted that a scarcity of organic nitrogen retarded revegetation more than any other factor. Eggler (1959) suggested that ammonium chloride deposits, which are abundant on the cone of Parícutin, may provide a nitrogen source for plants.

Substrates on the cone in which plants were growing can be roughly classified into three types: Moist ash near fumarolic vents, relatively coarse lapillae on the crater sides, and ash on the crater rim away from fumerolic vents. Eight species were found by the fumerolic vents, five in the lapillae on the side of the crater, and only one, a small seedling, in ash away from fumerolic vents on the rim of the crater. No plants were found on the outer slopes of the cone, possibly because the rubble is coarser and less stable, and there is a lack of fumerolic vents. The concentrations of plants in wet habitats on both the cinder cone and on surrounding lava flows suggest that water is an especially important factor in enabling species to become established. A thorough assessment is needed of the role of non-vascular species in modifying habitats on the volcanic materials.

The success in establishment of species on the cone should be reflected, to a certain extent, in their maturity and vigor. A rather long period would have been necessary for the two woody species, *Pinus montezumae* ? and *Buddleia cordata*, to attain a reproductive age. Three herbaceous angiosperm species, *Aegopogon cenchroides*, *Conyza coronopifolia*, and *Gnaphalium attenuatum*, had flowered; and two ferns, *Pellaea ternifolia* var. *ternifolia* and *Pityrogramma tartarea*, had produced sporangia. The other species were still only in a vegetative state. All of the fern species had a distinctly juvenile appearance. Although none of the plants were especially robust, the fact that five species had reached reproductive maturity is noteworthy.

Most of the species observed on the lava at the eastern base of the cone were more vigorous than those on the cone, yet that lava could hardly have been colonized by plants any earlier than the cone itself. Part of this area received one of the last flows to be emitted from the Volcano in 1952

(Fries and Gutiérrez, 1954). *Eupatorium pazcuarense* ? on the lava had flowered in the previous season, and both species of *Gnaphalium* and the *Buddleia* were exhibiting vigorous growth. Several healthy specimens of *Calamagrostis pringlei (Beaman 2389*, not present on the cone) were also well established. In the lava there are numerous basins, protected crevices, and caves to collect ash, silt, and water which produce conditions favorable for plant growth. Likewise, greater protection against extremes of evaporation and erosion is afforded by the lava. Clausen (1959) reported finding eight species of ferns, two mosses, and two Gnaphaliums on lava (deposited 11 years before his visit) near San Juan Parangaricutiro. Eggler (1959) indicated that in 1950 he found a blue-green alga and mosses growing on flows after three years, and after four years three species of ferns were established.

The brief period between the cessation of activity by the Volcano and the discovery of plants on its cinder cone demonstrates that only a short time is necessary for the initiation of primary succession. Parícutin now provides a model design for the study of plant dispersal, establishment, succession, and community development on inorganic volcanic products. — DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, MICHIGAN STATE UNIVERSITY, EAST LANSING.

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CONTRIBUTION TO THE FUNGUS FLORA OF NORTHEASTERN NORTH AMERICA[1]

HOWARD E. BIGELOW AND MARGARET E. BARR[2]

In the following account, seven species of agarics are discussed by the senior author. *Hygrophorus purpureofolius* is described as a new species, and the new combinations *Clitocybe hudsonianus* (Jenn.) Bigelow and *Lyophyllum multiforme* (Pk.) Bigelow are proposed. Information on the three pyrenomycetes has been prepared by the junior author, and the new combinations *Anisostomula rubescens* (Ell. & Everh.) Barr and *Gnomonia acerophila* (Dearn. & House) Barr are proposed.

Acknowledgment is made to the Faculty Research Council, University of Massachusetts, for financial support of our field program during 1958 and 1959. We also wish to express our appreciation to the following for the privilege of examining type material: Dr. L. R. Hesler, Department of Botany, University of Tennessee; Dr. Clark T. Rogerson, Curator, Cryptogamic Herbarium, New York Botanical Garden; Dr. A. H. Smith, Director, Herbarium, University of Michigan; Mr. Stanley J. Smith, Senior Curator of Botany, New York State Herbarium.

Colors cited in the descriptions of agarics, except in the case of *Clitocybe hudsonianus*, are from Ridgway, R. 1912. Color standards and color nomenclature, Washington, D. C. The colors given for *Clitocybe hudsonianus* are from Villalobos-Dominguez, C. and J. Villalobos. 1947. Atlas De Los Colores, Buenos Aires.

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Clitocybe compressipes (Pk.) Saccardo, Syll. Fung. 5: 184. 1887

Agaricus compressipes Peck, N. Y. State Mus. Rep't 33: 18. 1880.
Omphalia graveolens Petersen, Danske Agaricaceer, p. 137. 1907.
Clitocybe farinacea Murrill, N. Amer. Fl. 9: 401. 1916.

Pileus 1-3 cm. broad, convex at first with margin narrowly incurved and inrolled, disc slightly depressed at times, expanding to convex or plane, disc usually depressed, margin even, surface with thin hoary coating, becoming appressed, ground color a watery buff to brownish ("vinaceous buff", "pinkish buff", "cinnamon buff"), hygrophanous, soon fading to whitish or pale buff ("light buff", "pale ochraceous buff", "pale pinkish buff"); flesh concolorous with the pileus, thin, cartilaginous-brittle, odor and taste farinaceous.

Lamellae short decurrent to moderately decurrent, close and moderately broad in expanded specimens, sometimes narrow and subdistant when young, rarely forked, not intervenose, whitish.

Stipe 1.5-3.5 cm. long, 1-6 mm. thick at the apex, equal or either end enlarged, base usually with slight whitish tomentum, at times with a few slender rhizoids, solid, rarely eccentric, often curved, compressed at times, surface with whitish fibrillose coating, thin and soon appressed except at apex, ground color near that of moist pileus, not fading.

Spores (5-)5.5-8 x (2.5-)3-5 μ (up to 11 μ long from 2-spored basidia), elliptical or ovate, smooth, amyloid, white in mass; basidia 25-32 x 5.5-8 μ, usually 4-spored, occasionally 2-spored; filamentous cheilocystidia present, distribution variable, abundant on some lamellae, sparse or absent on others, protruding 23-62 μ beyond the edge of lamellae, 1-3 μ in diameter, smooth, hyaline; pileus tissue: surface somewhat gelatinous in KOH but not a true pellicle, cuticular hyphae cylindrical, 2.5-4 μ in diameter, sometimes with dilute yellowish or brownish intracellular pigment in KOH, trama hyaline, hyphae usually somewhat inflated, 6-16 μ in diameter, clamp connections present; gill trama regular.

Scattered to gregarious, rarely subcespitose or solitary. In the open in grass, in soil under hemlock or pine, on sandy road shoulder in mixed woods. July to October.

Material examined: *Bigelow 6841*, Amherst, Mass., July 12, 1958; *6908*, Hatfield, Mass., July 16, 1958; *6947*, Hawley, Mass., July 17, 1958; *7502*, Leverett, Mass., Aug. 14, 1958; *7632*, N. Amherst, Mass., Aug. 27, 1958; *7730*, same locality, Sept. 14, 1958; *7800*, same locality, Sept. 20, 1958; *8745*, Leverett, Mass., Oct. 13, 1959; *C. H. Peck*, Albany, N. Y., July (type of *C. compressipes*).

Clitocybe compressipes is one of the group of species having smooth amyloid spores, clamp connections, and filamentous cheilocystidia, which Singer (1951) includes in the genus *Cantharellula*. *C. felleoides* Kauffman, *C. intermedia* Kauffman, *C. farinacea* Murrill, *Omphalia kalchbrenneri*

Bresadola, and *Omphalia graveolens* Petersen must be considered in a discussion of the relationships of *C. compressipes*.

There is no difficulty in separating *C. compressipes* and *C. felleoides*. The lamellae of *C. compressipes* are close and whitish, whereas in *C. felleoides* they are distant and yellowish.

Clitocybe intermedia I know only from my examination of the type collection and Kauffman's (1927) original description. The distinguishing characters from *C. compressipes* are: pileus "orange cinnamon", lamellae narrow and often yellowish, stipe hollow.

As described and illustrated by Bresadola (1883, 1928), *Omphalia kalchbrenneri* is also distinct from *C. compressipes*. The striate pileus, distant and long decurrent lamellae, absence of farinaceous odor and taste, long spores (8-10 μ), are all features which are different from *C. compressipes*.

Clitocybe farinacea Murrill is here placed in synonymy with *C. compressipes* for my study of the type specimens of both species has not revealed any critical differences. Singer (1951) regards *C. farinacea* as a synonym of *O. kalchbrenneri*, but I do not believe this disposition is tenable. The strong farinaceous odor and taste of *C. farinacea* and spores 6-8 μ long are features of *C. compressipes* not *O. kalchbrenneri*. Singer (1951) also has placed *Omphalia graveolens* Petersen in synonymy with *O. kalchbrenneri*. However, Peterson (1907) emphasizes a distinct farinaceous odor for *O. graveolens* and spores 7-8 μ long, again features of *C. compressipes* rather than *O. kalchbrenneri*. Kühner's (1954) interpretation of *O. graveolens* is much broader than the original and seems to encompass not only *C. compressipes* and *O. kalchbrenneri* but also *C. felleoides*.

C. compressipes f. *autumnale* Kauffman has nonamyloid spores, 4-5 $\times$ 2.5-3 μ, and is not related to *C. compressipes*. It seems likely that *C. compressipes* f. *autumnale* is within the range of *C. regularis* Peck or *C. angustissima* (Lasch) Kummer.

Clitocybe highlandensis Hesler and Smith, Lloydia 6: 254. 1943

As far as known, this is the first report of this *Clitocybe*

outside of North Carolina and Tennessee. The two collections from Massachusetts cited below have been compared with the type collection and found to be identical with it in all respects.

C. highlandensis belongs to the section *Disciformes* and probably should be placed near *C. harperi* Murrill because of the general aspect and the absence of clamp connections. The spores of *C. highlandensis* appear very slightly granose-roughened under an oil immersion lens, but the lack of clamp connections and a white spore deposit prevent the inclusion of this species in the genus *Lepista.*

Material examined: *Bigelow 8406*, Leverett, Mass., Aug. 11, 1959; *8554*, New Salem, Mass., Sept. 2, 1959; *Hesler and Smith 7537* (type), Highlands, N. C., Sept. 10, 1937.

Clitocybe hudsonianus (Jenn.) Bigelow, comb. nov.

Hygrophorus hudsonianus Jennings, Mem. Carnegie Mus. pt. III (Botany), **12**: 2. 1936.

Pileus 8-23 mm. broad, convex at first, disc soon becoming shallowly depressed, margin crenate and faintly pellucid-striate at times, expanding to broadly convex, finally plane or rarely broadly infundibuliform, surface glabrous or with white pubescence about the disc, somewhat waxy-appearing at times, hygrophanous, color bright orange-yellow when moist (O 18-12°, OOY 18-12°) fading very slowly to whitish (O 19-6°); flesh thin, rather brittle and cartilaginous, concolorous with surface of pileus and fading in a similar manner, odor and taste not distinctive.

Lamellae adnate at first, soon becoming short decurrent, finally moderately decurrent, subdistant, broad (3-4 mm.), waxy-appearing, near concolorous with the moist pileus but not fading, edges even.

Stipe 1.5-2 cm. long, 1.5-3 mm. broad, usually equal, base with a small amount of white tomentum, fistulose, often curved, surface white-pubescent, pallid or pale orange-yellow (OOY 18-6°, O 19-6°) beneath the pubescence.

Spores 6-8(-9) x 4-5.5(-6) μ, usually elliptical or obovate, rarely oblong or subglobose, smooth, not amyloid, pale orange-yellow in mass (nearest OOY 19-12°); basidia 29-52 x 5.5-7(-8) μ, usually 4-spored, rarely 2-spored, sterigmata 5-6.5 μ long; cystidia: caulocystidia present, 60-130 μ long, 5-8 μ in diameter, hyaline, walls thin and smooth; pileus tissue: ± homogeneous, hyphae usually cylindrical, 2-8 μ in diameter, hyaline in KOH, clamp connections absent; gill trama interwoven, hyphae cylindrical, 2-5 μ in diameter.

Gregarious to subcespitose, on tundra. July and August.

Material examined: Mt. Albert, Gaspé Parc, Quebec, *Bigelow 5306, 5307, 5308, 5310, 5311, 5312, 5313, 5314, 6180;* Whiteface Mt., New York, *S. J. Smith.*

This species fruited abundantly on top of Mt. Albert in July and August of 1957. Frequently, the carpophores were growing near or intermixed with *Clitocybe umbellifera* (Fr.) Bigelow. The two species were the most abundant agarics to be found on this mountain top. Both are typical of a more northern flora, as is the other vegetation in this locality.

Emphasis has been placed upon the colored spore deposit of *C. hudsonianus* in making the transfer from *Hygrophorus*. Such a character is not uncommon in *Clitocybe*, but is decidedly atypical of *Hygrophorus*. Although the waxy-appearing lamellae of *C. hudsonianus* may indicate some intermediate relationship with *Hygrophorus*, it appears to be most closely related to such clampless species as *C. umbellifera* (Fr.) Bigelow and *C. luteovitellina* (Pilat and Nannfeldt) Bigelow.

Except for the waxy nature of the lamellae, *Clitocybe hudsonianus* is identical in appearance with *C. luteovitellina* (Pilat and Nannf.) Bigelow. They are also identical in microscopic characteristics except for spore shape and width. Those of *C. hudsonianus* are variable in shape and 4-5.5(-6) μ broad. *C. luteovitellina* has elliptic-oblong spores which are variously reported as: 3-4 μ broad (Moller, 1945, as *Omphalia flava)*, (Pilat and Nannfeldt, 1954, as *Omphalia luteovitellina)*; 3.5-4.3 μ (Favre, 1955, as *Omphalia flava)*; 4-4.9 μ (M. Lange, 1955 as *Omphalina flava)*; 4-5 μ (Bigelow, 1959). The similarity of these two species requires a critical observation in the field on the texture of the lamellae of *C. luteovitellina* and further study on spore variation.

Clitocybe umbonata (Fr.) Konrad, Bull. Soc. Myc. Fr. 47: 146. 1931

A pure white form of this common agaric was found Oct. 13, 1959 in Leverett, Mass. (Bigelow 8740). About twenty-five carpophores were found growing in a gregarious fashion on Polytrichum in an abandoned pasture. The typical form with grayish pilei was found in other groups a few yards distant. Except for the absence of pigment, the albino form had all the characteristics of *C. umbonata*.

Hygrophorus purpureofolius Bigelow, sp. nov. Plate 1253

Pileus 1-5 cm. latus, convexus demum planus, haud pellucidus, glaber,

PLATE 1253. *Hygrophorus purpureofolius* sp. nov. × 1½.

primum rubro-aurantiacus, tum aurantiacus, hygrophanus, demum flavus; lamellae adnatae vel decurrentes, confertae vel subdistantes, latae, violaceae; stipes 2.5-7 cm. longus, apice 4-9 mm. crassus, saepe compressus, cavus, glaber, pileo concolor; sporae 7-11 x 4-5.5 μ.

Specimen typicum in Herb Univ. of Mass. conservatum; legit Savoy Mt. State Forest, Mass., Aug. 7, 1959, *Bigelow 8363*.

Pileus 1-5 cm. broad, conic or campanulate at first with the margin incurved and slightly inrolled, soon convex or broadly convex, finally plane and margin often somewhat undulate, surface opaque and dull, glabrous, not viscid, moist and hygrophanous, a dark reddish-orange when young ("vinaceous rufous", "Hays russet", "Kaiser brown", "Mars orange"), becoming paler and more orange when expanded ("burnt sienna", "orange rufous"), usually fading from the disc outward, radiate-streaked or squamulose in fading, becoming a rather bright yellowish-orange (nearest "deep chrome"); flesh thin, brittle, concolorous with the moist pileus at first, fading to whitish or pale yellowish, odor and taste not distinctive.

Lamellae broadly adnate to short decurrent, close to subdistant, broad (2-6 mm.), rather brittle, thick and waxy-appearing, dull lavender to purplish (nearest "pale purple drab", "pale vinaceous drab", "purple drab", "vinaceous drab", "deep dull lavender"), with a yellowish cast in age, edges even.

Stipe 2.5-7 cm. long, 4-9 mm. thick at apex, equal or enlarged at either end, ventricose at times, often compressed and with a vertical groove, usually curved or flexuous, hollow, surface glabrous, concolorous with the moist pileus and not fading appreciably, base with whitish or lilac-colored tomentum.

Spores 7-11 x 4-5.5 μ, elliptical to elliptic-oblong, at times obovate, smooth, not amyloid, spore print not obtained; basidia 42-55 x 6-8 μ, 2-spored and 4-spored; cystidia not differentiated; pileus tissue: faintly yellowish in KOH, pigment apparently intercellular and intracellular, somewhat soluble in water and KOH, cuticular hyphae cylindrical or slightly inflated, 2.5-7.5 μ in diameter, end cells often protruding, subclavate or clavate, $<$ 10 μ in diameter, tramal hyphae mostly inflated, 7.5-14.5 μ in diameter, clamp connections present, scattered thick-walled hyphae present; gill trama subregular to regular, hyphae usually somewhat inflated, (2.5-)6-10(-12) μ in diameter.

Gregarious to subcespitose, on leaves and humus, under birch and maple, or in a mixed woods of birth, maple, and hemlock. August.

Material examined: Savoy Mountain State Forest, Florida, Mass., *Bigelow 8361, 8362, 8363* (type), *8364, 8365, 8421, 8422, 8423*.

The purplish gills are an unusual characteristic for species in the subgenus *Hygrocybe*, to which *Hygrophorus purpureofolius* belongs. The color is striking in the field and is usually evident even after the specimens have been dried. *H. mephiticus* Peck, described from Massachusetts, has violaceous gills, but is distinctive by the yellow-brown pileus

and stipe and a mephitic odor. *H. troyanus* Murrill, described from Jamaica, also has similarly-colored gills but is a small viscid species.

Hygrophorus tennesseensis Smith and Hesler, Lloydia 2: 40. 1939

Four collections of this species were found during the fall of 1959. All were found growing in a gregarious fashion on needles under white pine. The characteristics of the carpophore checked with those of the published description by Smith and Hesler (1939). Dr. L. R. Hesler of the University of Tennessee has kindly compared some of the dried specimens with the type collection, and found complete agreement on all observable features.

The following records apparently represent the most northern occurrence of this species so far to be noted.

Material examined: *Bigelow 8616*, Chesterfield, Mass., Sept. 8, 1959; *8640*, Conway, Mass., Sept. 13, 1959; *8387*, Leverett, Mass., Oct. 4, 1959; *8731*, Shutesbury, Mass., Oct. 10, 1959.

Lyophyllum multiforme (Peck) Bigelow, comb. nov.

Clitocybe multiformis Peck, N. Y. State Mus. Mem. 4: 141. 1900.

Pileus 2-7 cm. broad, convex at first, expanding to broadly convex or plane, broadly subumbonate at times, glabrous, dull, watery whitish with a creamy to pale yellowish tint when moist (nearest "cream buff"), margin finely pellucid-striate in expanded specimens, hygrophanous, fading to white and opaque, edge becoming brown at times; flesh moderately thick on the disc, thin on the margin, watery and concolorous with the moist pileus, fading to whitish, brittle, no odor, taste slightly acidulous.

Lamellae adnexed to adnate or short decurrent, evenly and forming a collar on the stipe apex, close, narrow, whitish (nearest "cream buff"), edges even.

Stipe 3.5-8.5 cm. long, 5-13 mm. thick at the apex, base often curved and strigose, hollow at times and compressed, surface innately fibrillose-striate, often silky and shining, white.

Spores 5.5-7.5 x 2.5-3.5(-4) μ, elliptical or rarely elliptic-oblong, smooth, not amyloid, white in mass; basidia 23-35 x 3-7 μ, usually 4-spored, occasionally 2-spored, aceto-carmine granules present; cystidia not differentiated; pileus tissue: surface somewhat gelatinous in KOH, cuticular hyphae cylindrical, 1.5-3.5 μ in diameter, tramal hyphae cylindrical to inflated, 3.5-11 μ in diameter, clamp connections present; gill trama subregular, hyphae usually cylindrical, 3.5-8 μ in diameter.

Gregarious to cespitose, on wood debris, under hardwoods, September and October.

Material examined: Sunderland, Mass., *Bigelow 7782, 7853, 7914*; *C. H. Peck*, Meadowdale, Albany Co., N. Y., October (type).

The pallid pileus and elliptical spores distinguish *Lyophyllum multiforme* from all species of the section *Difformia* but *L. connatum* (Fr.) Singer. In a comparison with the latter, *L. multiforme* is distinct by the hygrophanous, striate pileus and absence of an odor. *L. connatum* is shining white and with a farinaceous odor.

Anisostomula rubescens (Ell. & Ev.) Barr, comb. nov.
Figs. 4, 5

Laestadia rubescens Ellis and Everhart, North American Pyrenomycetes, p. 259. 1892.

Perithecia 100-200 μ in diameter, 80-150 μ high, depressed-globose, collapsing when dry, immersed, loosely grouped as brown dots on yellowish irregular areas of the upper leaf surface, rarely hypophyllous, wall 15-18 μ wide at sides and base, of several layers of compressed yellowish cells, at the apex dark brown or reddish brown, thickened and forming a slight clypeus by radiating dark hyphae, pore variable, 18-40 μ wide, periphysate, with light brown hyphae in leaf tissues.

Asci 45-54 x 5.5-10 μ, oblong to broadly cylindrical, apex rounded or truncate, short stalked, wall single, thin and delicate, thickened at the apex, with refractive points of projecting cytoplasm, in iodine the pore outlined in bright blue, as two globules in side view, paraphyses few, delicate, 2-3 μ wide, septate, guttulate.

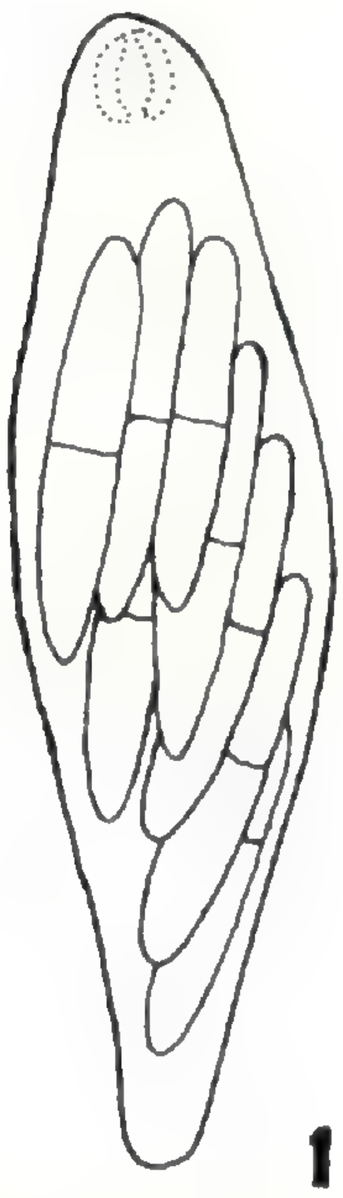
Spores 6.5-10 x 4.5-5 μ, hyaline, ovoid to ellipsoid, ends rounded to obtusely pointed, straight to inequilateral, 1-celled, wall double, smooth, often surrounded by a guttulate sheath when emerging from the ascus, contents refractive, with two globules, one near each end, obliquely uniseriate or partially overlapping biseriate in the ascus.

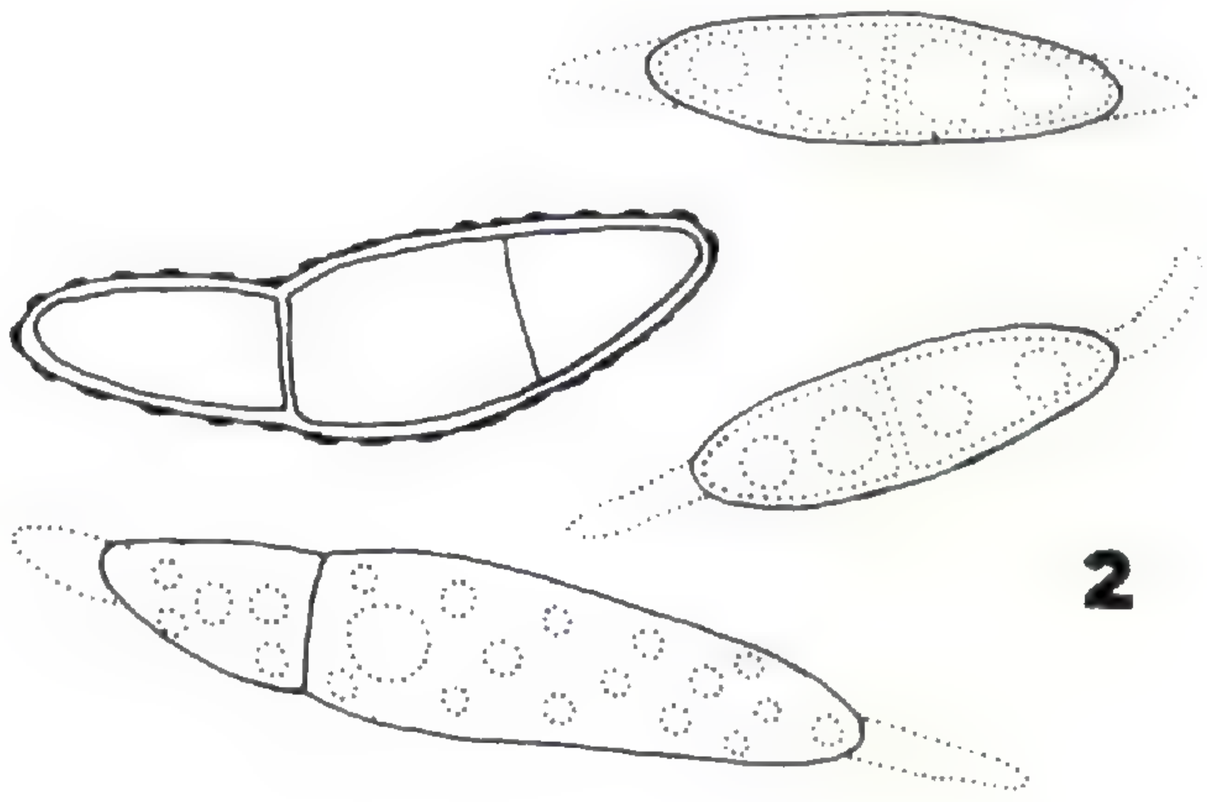
On overwintered leaves of *Castanea dentata*, still hanging from the branch.

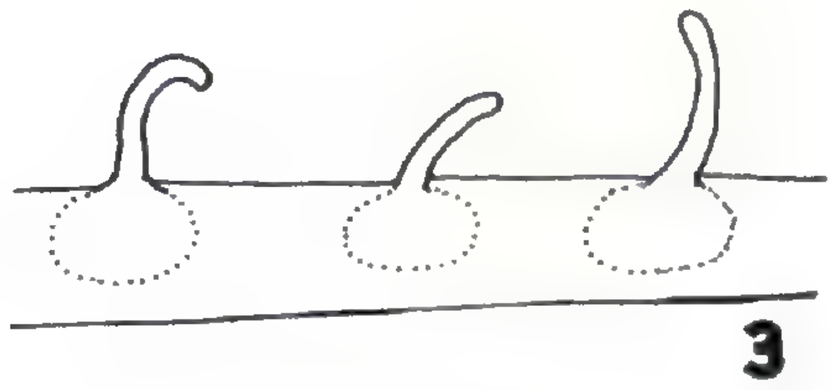
Material examined: Mt. Grace State Forest, Warwick, Mass., July 28, 1959, *Barr 2609; J. B. Ellis*, Newfield, N. J., April 4, 1891 (type of *Laestadia rubescens*).

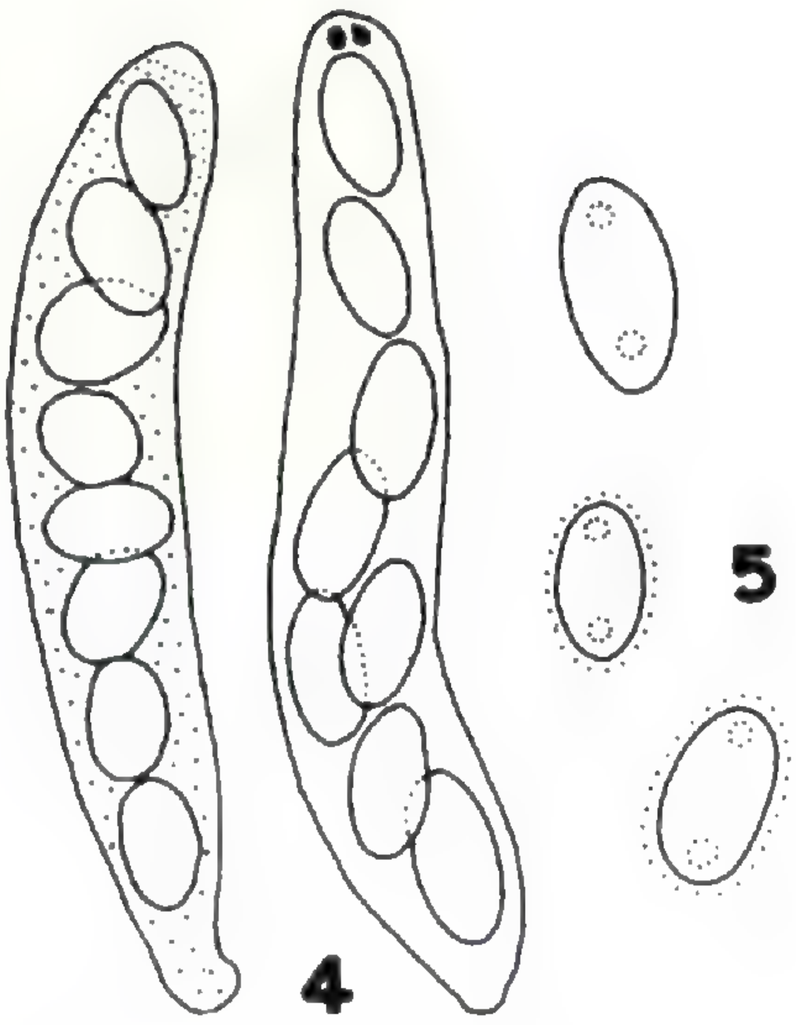
According to von Arx and Müller (1954), the genus *Anisostomula* includes four species, all occurring on leaves of species of *Quercus* in various regions of Europe. Both the type material of *Laestadia rubescens* and my own collection agree in all respects with the generic diagnosis. Of the previously described species of *Anisostomula*, *A. rubescens* appears to be most closely related to *A. areola* (Fckl.) von Höhnel. *A. areola* has a similar perithecial wall, thin and light colored at the sides and darkened and clypeal around the pore. However, the spores in *A. areola* are narrower (3-4 μ wide) and are arranged biseriately in the ascus.

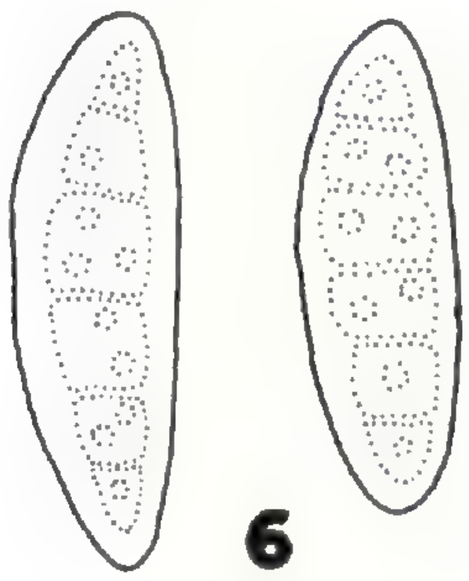
A search of the literature produced the descriptions of three species of "Laestadia" on leaves of *Castanea*, all of which bore some resemblance to my fungus. The type specimens of *Laestadia orientalis* Ellis and Everhart (Proc. Acad. Nat. Sci. Phila. 1890: 230. 1891) and *L. castanicola* Ellis and Everhart (North American Pyrenomycetes, p. 259.











FIGS. 1-3. *Gnomonia acerophila:* 1, ascus showing refractive apex, 2, ascospores, 3, habit of perithecia in petiole. FIGS. 4, 5. *Anisostomula rubescens:* 4, two asci, that on the right in iodine to show blue-staining apical pore, 5, ascospores. FIG. 6. *Trichometasphaeria gloeospora*, two ascospores from type material of *Leptosphaeria asparagi*. Figs. 1, 2, 4, 5, 6 × 1500; fig. 3 × ca. 20.

1892), proved to be identical. Both have a diaporthaceous structure, no beak or a very short broad one, and one-celled spores. These two collections are identical with European and North American specimens of *Sphaerognomonia carpinea* (Fr.) Potebnia on *Carpinus*. The names *L. orientalis* and *L. castanicola* are to be regarded as synonymous with *S. carpinea*. Incidentally, Miller and Thompson (1940) have already reported *S. carpinea* on leaves of a number of deciduous trees in Georgia. I have also found this species on leaves of *Quercus rubra* var. *borealis* in Massachusetts (Barr 2552 and 2560). The type specimen of *Laestadia rubescens* is identical with the material from Massachusetts. The asci and spores are somewhat larger than Ellis and Everhart (1892) gave (asci 40 × 6 μ, spores 5-6 × 3.5-4 μ) in their description.

Gnomonia acerophila (Dearness and House) Barr, comb. nov. Figs. 1-3

Gnomoniopsis acerophila Dearness and House, N. Y. State Mus. Bull. **233-234:** 36. 1921.

Perithecia 420-600 μ in diameter, 350-400 μ high, immersed, depressed-globose, scattered to grouped, beaks erumpent, 300-1000 μ long (rarely up to 2 mm. long), 100-130 μ wide near base, narrowed to 60-70 μ wide near apex, central to somewhat lateral, curved, somewhat irregular, wall blackened, hyaline near apex, periphysate, perithecial wall 20-33 μ wide, of one to two layers of dark brown, large cells externally, and inner layers of compressed hyaline cells.

Asci 50-87 x 12-16.5 μ, ellipsoid, narrowed to the rounded apex and short-stalked base, wall delicate, with two elongate refractive areas at apex, no blue in iodine, aparaphysate.

Spores 16.5-33 x 4-6.5 μ, greenish hyaline, becoming yellowish in age, at times dull brown, cylindric-fusoid, ends rounded to pointed, straight to slightly curved, 1-septate in the middle or below it, not constricted, in age a second septum formed in the upper cell, appendaged at both ends, appendages hyaline, (2-) 5-9 (-11) μ long, 1-2 μ wide, truncate or pointed, straight or curved, wall double, smooth but in iodine becoming slightly roughened or irregular, in overmature brown spores roughened with brown granules, contents with two large globules in each cell, in a fascicle in the ascus.

On petioles, overwintered, of *Acer* spp.

Material examined: *Acer pennsylvanicum*, Oneida, N. Y., May 15, 1918 (type of *Gnomoniopsis acerophila*); *Acer rubrum*, Huntington Forest, N. Y., June 29, 1957, *Barr 1888A*; *Acer* sp., Ste. Adele, Quebec, June 22, 1957, *Barr 1864*; *Ellis and Everhart*, North American Fungi *2139* (as *Gnomonia emarginata* Fckl.), Newfield, N. J., June, 1888.

The genus *Gnomoniopsis* (Wint.) Berlese was erected to

accommodate species of *Gnomonia* in which the spores developed more than one septum. This distinction is not sufficient to maintain a separate genus, and von Arx (1951) considers that *Gnomoniopsis* and *Gnomonia* are the same. Dearness and House (1921) described the spores of *Gnomoniopsis acerophila* as one to five septate, but the type material contains spores with one primary septum, and rarely a secondary very thin septum in the upper cell. According to the collections examined, *G. acerophila* is most closely related to *G. campylostyla* Auerwald, on leaves of *Betula*. Both species have the beak frequently crooked and irregular, varying in position from central to lateral. In both the asci are large with elongate refractive areas at the apex. The spores of *G. campylostyla*, from material which I have collected, measure 18-25.5 × 3 μ, rarely show faint appendages at the tips, and at times have two additional septa. *G. acerophila* may be separated from *G. campylostyla* by its habit on petioles, rarely extending a short distance up the midvein, its longer, stouter beak, and the broader spores with distinct appendages.

The specimens issued by Ellis and Everhart in North American Fungi 2139 as *Gnomonia emarginata* Fuckel agree in all respects with my material of *G. acerophila*. According to the literature, *G. emarginata* is confined to petioles of *Betula* spp., and has curved, one-celled, biguttulate spores, narrower than those of *G. acerophila*.

Gnomonia acerophila differs from the other species of *Gnomonia* reported on *Acer* in larger sizes throughout, in its long, bent beaks, and in being confined to petioles of the leaves.

Trichometasphaeria gloeospora (Berk. and Curr.) Holm, Symb. Bot. Upsalienses 14(3): 144. 1957. Fig. 6

Holm (1957) has given a detailed description and synonymy of this fungus. To the synonymy of *T. gloeospora* should be added *Leptosphaeria asparagi* Peck (N. Y. St. Mus. Rep't 40: 70. 1887). Ellis and Everhart (1892) have previously included Peck's species as the same as *Leptosphaeria comatella* (Cke. and Ell.) Saccardo. The latter is identical with *T. gloeospora*, as Holm has observed. I have studied type material of Peck's *L. asparagi*. It agrees in all

respects with Holm's description of *T. gloeospora* and with specimens of *Sphaeria comatella* issued by Ellis. The Massachusetts material of *T. gloeospora* is similar to the other material examined and to Holm's description.

Material examined: on *Asparagus* stalks, North Amherst, Mass., June 3, 1959, *Barr 2556*; *Ellis* North American Fungi *190* and *190d*, Newfield, N. J. (as *Sphaeria comatella* Cke. and Ell.); Fungi Columbiana 1425a and 1425b, Newfield, N. J., (as *Leptosphaeria comatella* (Cke. and Ell.) Sacc.); on *Asparagus*, Menands, N. Y., Oct.. 1886, *C. H. Peck* (type of *Leptosphaeria asparagi*).

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ELYMUS ARENARIUS AND DIARRHENA AMERICANA IN WISCONSIN

HUGH H. ILTIS, JACK REED, AND THOMAS MELCHERT

There are few families that have been as thoroughly collected and worked on for the Flora of Wisconsin as the Gramineae. A book on the Grasses of Wisconsin (Fassett 1950) has been published which in turn is partially based on an unpublished Ph.D. thesis dealing with the Gramineae of the state (Shinners, 1943). It is therefore an uncommon event when a grass new to the state is discovered, or when substantial range extensions are recorded.

ELYMUS: The second author, under a research participation program supported by the National Science Foundation, has been engaged in a thorough floristic survey of the Point Beach State Forest, 4 miles north of Two Rivers, Manitowoc County, Wisconsin. Located on the shores of Lake Michigan, its diverse habitats, especially the beautiful dunes and swales, have long attracted botanical collectors. One of the 30 Wisconsin *Scientific Areas* is located in the forest.

Among the collections made last summer there was a well-developed specimen of **Elymus arenarius** L., the first record for this northern European strand species from Wisconsin. Swezey (1883) listed for Wisconsin the closely related *Elymus mollis* Trin. without precise locality, and no voucher specimens are known to back his report. It is possible that this is based on a collection of *Elymus arenarius*. *Elymus mollis*, a native North American species, does not occur in Wisconsin, its closest stations being on Lake Superior in Upper Michigan[1].

The specimen (Reed 381-WIS) grew on shifting sands of the first ridge of dunes paralleling the Lake Michigan strand, between, and south of, the main lodge and the lighthouse (T-20-N; R-25-E; Sect. 9). Its associated grass species, all very characteristic of the dunes, included *Ammophila breviligulata*, *Calamovilfa longifolia* var. *magna*, the endemic, as yet unnamed Great Lakes ecotype of *Agropyron dasystachyum*, as well as *Agropyron trachycaulon*, *A. repens*, *Elymus ca-*

[1]We are grateful to our "rival" floristic worker, Dr. Ed Voss of the University of Michigan, Ann Arbor, for calling our attention to Dr. Bowden's paper, and for this distributional information.

nadensis and *Koeleria cristata*. The specimen was in full fruit when collected on July 9.

The taxonomic confusion surrounding *Elymus mollis* and *E. arenarius* has been carefully and thoroughly elucidated by Bowden (1957). All Illinois collections of *E. mollis* cited by Jones (1955), who followed Hitchcock and Chase (1950), are *E. arenarius*. To these two Illinois collections, both from Cook County, we may add the following, based on a specimen deposited at WIS: Lake County: Lake Forest, Dec. 8, 1918, *L. S. Cheney s.n.*

Diarrhena americana: Fassett (1950) cites only one sheet of this species, since identified as var. *obovata* Gleason by Dr. Dennis Anderson, from Fayette, Lafayette County, Wisconsin, 1894, with no exact location data given. Attempts by the senior author to relocate this stand were unsuccessful. During the last two years, this taxon was rediscovered in Wisconsin at two localities. A large clone some 10 feet in diameter was found by the senior author in a very fine floodplain forest, the so-called "Avon Bottoms", along the Sugar River, 2 mi. SE of Avon (SW of the new bridge), in southwesternmost Rock county. Here, in association with *Quercus bicolor* (14′7″ Diam. at breast heighth, the largest in Wisconsin!), *Q. macrocarpa, Ulmus americana, Acer saccharinum, Celtis occidentalis* and *Tilia americana,* grow a wealth of species, including some southern ones otherwise rare in most of Wisconsin, such as *Platanus occidentalis, Arabis shortii, Arisaema dracontium, Cephalanthus occidentalis, Chaerophyllum procumbens* — an abundant annual Umbelliferae here at its only Wisconsin station, *Evonymus atropurpureus*, and *Menispermum canadense.*

The third author found fully mature specimens of *Diarrhena* in a deciduous open forest along the Kickapoo River below Wisconsin Highway 131, in southern Monroe County (T-15N; R-2W; Sect. 13), a station some 100 miles to the north of the nearest previous one. The grass may actually be more common in Wisconsin, but perhaps is collected rarely since it fruits in late summer, a time when, in the past at least, collecting activity at Wisconsin was at a minimum.

The field trips of the first and third authors have been supported by the Research Committee of the Graduate School of the University of Wisconsin from funds supplied by the

Wisconsin Alumni Research Foundation. — DEPARTMENT OF BOTANY, UNIVERSITY OF WISCONSIN, MADISON

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HERBARIUM TECHNIQUES. — 1. *A Quick Method for Preparing Permanent Mounts of Seeds or Small Fruits.* — The cardboard micropaleontological specimen slide, long a fixture in the geology laboratory, is remarkably well adapted for use by those botanists interested in making detailed studies of seeds or small fruit. Such slides, often referred to as "Cushman Foraminiferal Slides", are 1″ x 3″ or 1″ x 4″ rectangles of laminated cardboard into which circular or rectangular cavities of various depths and sizes have been cut. Standard diameter for circular cavities is 12.5 mm; standard dimensions for rectangular cavities are 45 mm x 20 mm. Depths ranging from 1 to 3 mm may be ordered for either circular or rectangular depressions. The floor of the cavities may be plain black (see figures 2, 3, 4, 5) or, in the rectangular type, may be black with a white grid of 60 numbered squares (see figure 1). Thus, in the latter type, as many as 60 separate achene or seed specimens could be mounted upon one slide. The lightness of the cardboard slides is a factor of great value in that samples prepared in this way may, after celluloid slide covers are attached, be easily glued to herbarium sheets. If, on the other hand, a separate seed collection is desirable, a large number of slides may be stored in a small space. All of the above described slides, together with slide covers and slide clips, may be obtained from the W. H. Curtin Company, Houston, Texas or New Orleans, Louisiana.

The micropaleontologist's method of preparing specimens of small fossils is similarly adaptable to botanical work. The

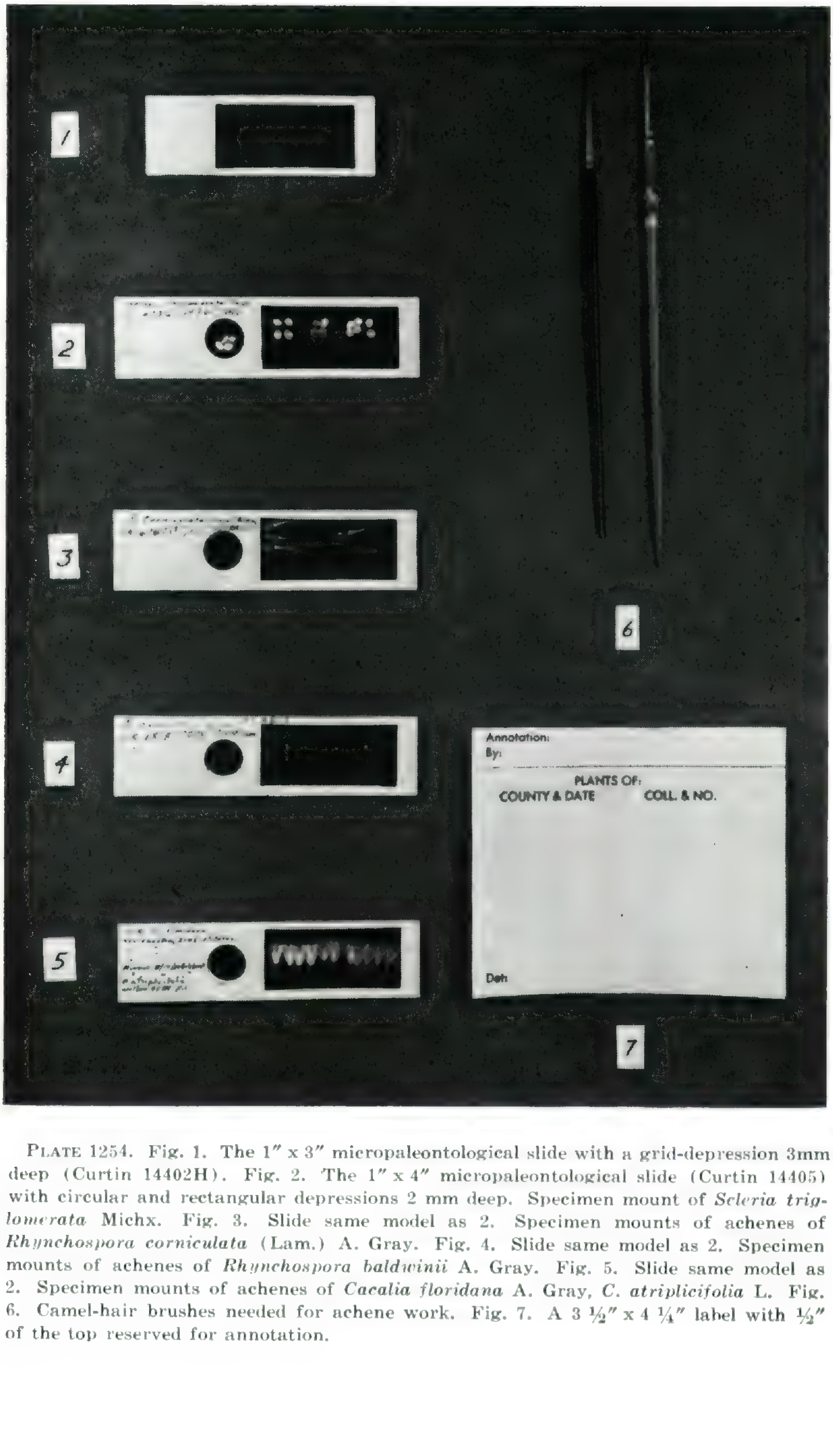

PLATE 1254. Fig. 1. The 1″ x 3″ micropaleontological slide with a grid-depression 3mm deep (Curtin 14402H). Fig. 2. The 1″ x 4″ micropaleontological slide (Curtin 14405) with circular and rectangular depressions 2 mm deep. Specimen mount of *Scleria triglomerata* Michx. Fig. 3. Slide same model as 2. Specimen mounts of achenes of *Rhynchospora corniculata* (Lam.) A. Gray. Fig. 4. Slide same model as 2. Specimen mounts of achenes of *Rhynchospora baldwinii* A. Gray. Fig. 5. Slide same model as 2. Specimen mounts of achenes of *Cacalia floridana* A. Gray, *C. atriplicifolia* L. Fig. 6. Camel-hair brushes needed for achene work. Fig. 7. A 3 ½″ x 4 ¼″ label with ½″ of the top reserved for annotation.

microfossils are "picked" individually from sample trays by means of a small, water-moistened, camel-hair brush, then transferred to a slide on which the worker has placed a small drop of glue (usually gumtragacanth in water). A similar brush may be used to apply the glue to the slide cavity. The specimen is then gently placed on the drop of glue which promptly takes it up and, nearly as promptly, dries. The glue is moderately strong but is quickly soluble in water. Therefore, should future studies demand, specimens may be easily extracted from the mount by teasing them loose with a moist brush; this could be done repeatedly with a minimum of damage either to specimen or slide.

Celluloid strips may be cut to a size appropriate for covering the slide cavities. The slides, plus covers, may be inserted into aluminum slide holders (clip-like structures measuring 76.5 mm x 28.0 mm) which hold the cover-slips in place.

Collection numbers of specimens may be entered on the elevated, white surface of the slide; or, if a numbered grid type of slide is being used, the corresponding collection numbers may be entered in a separate card file.

The slides, slide covers, and clips described above (also see the Curtin and Company catalogue for details) are ideal for storage of a large number of specimens within a small space.

2. *Specimen Labels with Built-in Annotation Slips.* — Modern revisions of taxa entail the laborious annotation of large quantities of herbarium specimens. Thus, considerable valuable time is expended solely upon the chore of attaching annotation labels to herbarium sheets. Often, if the specimen is bulky, the worker has difficulty in finding sufficient space on the sheet to place his annotation. Such expenditures of time could become unnecessary if label size were increased to have the locality label and annotation label as one unit. The extra width thus provided to the label is also advantageous in that the larger label tends to "slip" far less during typing. Indeed, space for more than one annotation could be added to a label; one inch of additional width would provide space for two annotations. — ROBERT KRAL, VIRGINIA POLYTECHNIC INSTITUTE.

Volume 62, No. 738, including pages 145-174 was issued July 8, 1960.

ow REFERENCE (Date)

SEP 1 1960

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

REED CLARK ROLLINS, Editor-in-Chief

ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
CARROLL EMORY WOOD, JR.
IVAN MACKENZIE LAMB
} Associate Editors

Vol. 62 August, 1960 No. 740

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

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Gray Herbarium, 22 Divinity Avenue, Cambridge 38, Mass.

Subscriptions and orders for back issues (making all remittances payable to RHODORA) should be sent to Albert F. Hill, Botanical Museum, Oxford Street, Cambridge 38, Mass.

Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

Rhodora

JOURNAL OF THE
NEW ENGLAND BOTANICAL CLUB

Vol. 62 August, 1960 No. 740

A SYSTEMATIC TREATMENT OF THE *PHACELIA FRANKLINII* GROUP[1]

GEORGE W. GILLETT

The New World genus *Phacelia* (Hydrophyllaceae) includes between 150 and 200 species (Constance, 1951) some native to South America; but the majority being restricted to North America, occurring from Guatemala to within 50 miles of the Arctic Circle. Brand (1913) divided the genus into six sections, four of these sections being relatively small and together comprising 33 species. The remaining two sections are comparatively large and nearly equal in size. One of these larger groups, the section Eutoca, is exclusively North American and is distinguished by corolla scales and the presence of more than four pitted seeds per capsule. The section Eutoca is probably an artificial assemblage of relatively distinct species groups. One of these, herein referred to as the *Phacelia Franklinii* group, is an aggregation of six montane to alpine to sub-arctic species. In addition to *P. Franklinii*, the group includes *P. Lyallii*, *P. lenta*, *P. mollis*, *P. idahoensis*, and *P. sericea*.

The current infra-generic classification of *Phacelia* is generally conceded to be inadequate. However, considerably more evidence must be accumulated before the various species groups can be accorded a classification that properly relates them to each other. It seems necessary, therefore, to defer the formal recognition of the *Phacelia Franklinii* group until enough knowledge is accumulated to make possible a realignment of the species groups of the entire genus.

[1]Supported by grant G-3886 from the National Science Foundation, and All-University Research Grant 2493, Michigan State University.

The growth pattern in these species is marked by the formation of a basal leaf rosette from which an inflorescence axis arises. Plants of *Phacelia Franklinii* are spring to summer-flowering biennials, or summer-flowering annuals; while those of *P. lenta*, *P. Lyallii*, *P. mollis*, *P. idahoensis*, and *P. sericea* are spring-flowering perennials. In distribution, the group extends from northern Arizona to Great Bear Lake, Canada, and from the Olympic Peninsula east to Lake Superior. Because of the variation and unreliability of the taxonomic characters previously employed in this group, an experimental study was initiated and evidence obtained from both living plants and herbarium specimens. All species, except *P. lenta* which is known only from the type collection, have been grown from seed.

The assistance of those who have obtained seed collections for this investigation is gratefully acknowledged. Appreciation is also extended to Dr. Lincoln Constance and to my colleagues Drs. Henry Imshaug and John Beaman for their discussions and criticisms. Special thanks are extended to the many herbarium curators who have made specimens available for this study. Herbaria are cited by the abbreviations of Lanjouw and Stafleu (1959).

Taxonomic History

The description of *Eutoca Franklinii* (and of the genus *Eutoca*) by Robert Brown (1823) marked the first recognition of a species in this group. Brown's description was based on material obtained in northern Saskatchewan by the first Franklin expedition. In 1830, Graham added the description of *Eutoca sericea*, based on material grown from seed collected in the Canadian Rockies by Drummond. These two species were illustrated in Curtis's Botanical Magazine in 1830, and have since been interpreted as distinct species.

Gray (1875) gave *Eutoca* subgeneric rank under *Phacelia*, and inferred a close relationship between *Phacelia Franklinii* and *P. sericea* by aligning them in a common group, at the same time describing *P. Lyallii* as a variety of *P. sericea*. Brand (1913) placed *P. Franklinii*, *P. lenta*, and *P. sericea* in the same group, and interpreted both *P. Lyallii* and *P. idahoensis* as subspecies of *P. sericea*.

Both *Phacelia linearis* and *P. procera* have been variously

aligned with species of the *P. Franklinii* group by Gray (op. cit.), Brand (op. cit.), and Howell (1945). To clarify these interpretations, both *P. linearis* and *P. procera* were included in certain aspects of this study.

Morphology and Cytology

MORPHOLOGICAL STUDIES. — *Flowers.* The corollas of most phacelias have linear appendages that are adnate along one edge to the inner surface of the corolla tube. Each appendage is fused to a lateral vein, there being two such appendages, or scales, at the base of each petal (Fig. 1). In *Phacelia linearis* and in species of the *P. Franklinii* group, these appendages are nearly parallel and are free of the stamen filaments. By contrast, the appendages of *P. procera* are strongly divergent and are fused across the filament bases, forming a pocket (Fig. 1-B). The appendages of *P. linearis* and of species of the *P. Franklinii* group overlie a nectary along the midvein, a feature that has been described by Constance (1949) in phacelias of the section Cosmanthus. The surface of this nectary is glabrous in *P. linearis* and in *P. Franklinii*, but is hairy in other species of the *P. Franklinii* group. The glabrous inner corolla surface and the numerous, long hairs of the stamen filaments generally distinguish the flowers of *P. Franklinii* from those of all other members of the *P. Franklinii* group. The glandular hairs on the lower portion of the stamen filaments of *P. linearis* suffice to distinguish this species from members of the *P. Franklinii* group.

Seeds. Seed-coat features have long been used in the classification of phacelias, and have proven useful in delimiting species of this study. These features are illustrated in Fig. 2. Seed-coat details were obtained from photographic enlargements on which the sculpturing detail was inked, with the remaining details subsequently bleached out. This technique revealed very subtle, but consistent differences in seed-coat sculpturing. The seed-coat sculpturing in *Phacelia linearis* is relatively coarse and is registered on the endosperm, while the sculpturing in other seeds is finer, and is restricted to the seed coat. The finely sculptured seed coat of *P. Lyallii* is most distinctive, and enables one to identify readily the seeds of this species when they are mixed with

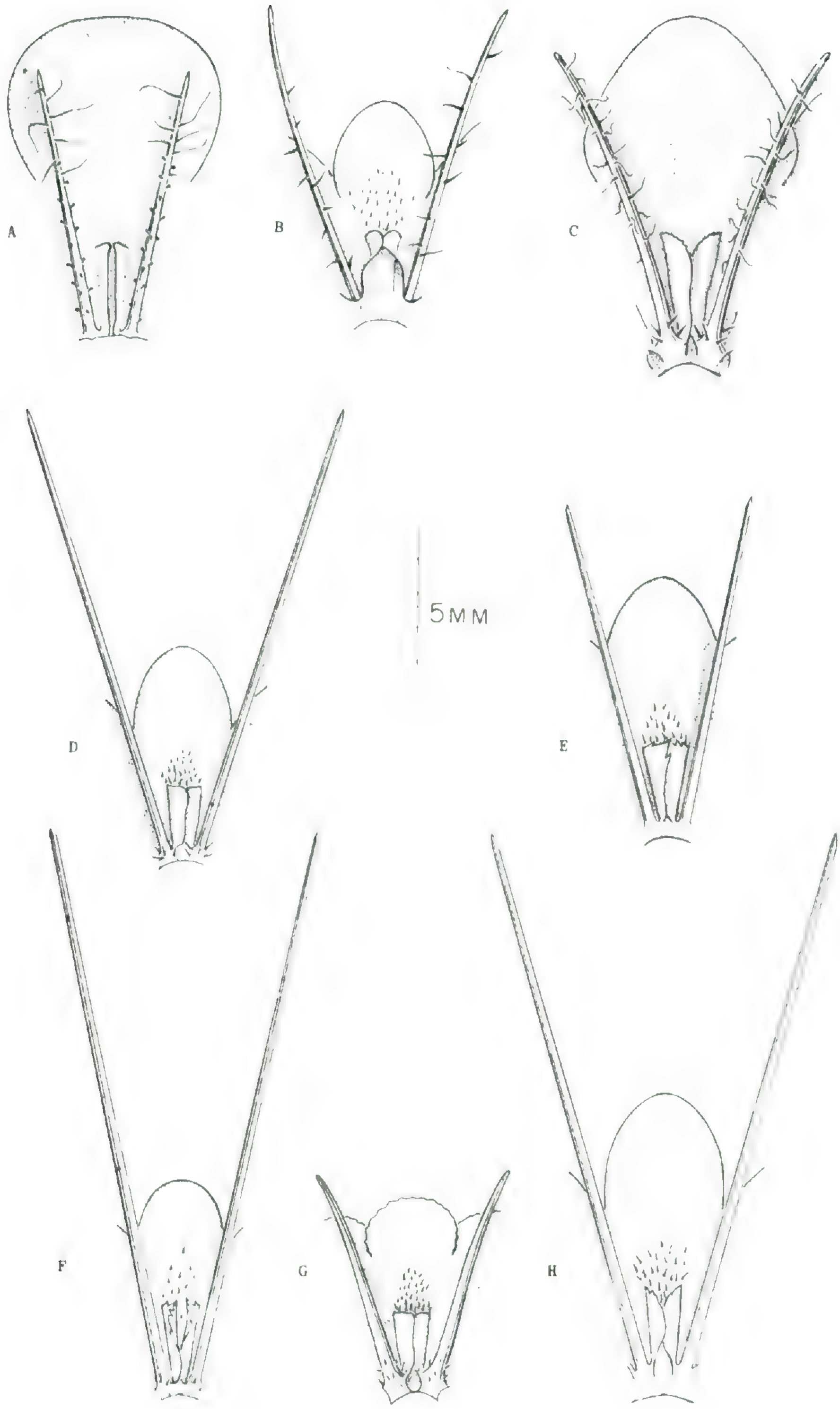


FIG. 1. Corolla morphology of: (A) *Phacelia linearis, Preece 2262* (MSC); (B) *P. procera, Richardson s.n.* (ID); (C) *P. Franklinii, Langenheim 4319* (MSC); (B) *P. sericea* subsp. *sericea, Gillett 1149* (MSC); (E) *P. Lyallii,* TYPE; (F) *P. lenta,* TYPE; (G) *P. idahoensis, Henderson 2770* (MSC); (H) *P. mollis, Smith 2407* (MSC).

those of other species included in this study. The seed-coat detail of *P. Franklinii, P. sericea, P. mollis,* and *P. idahoensis* is so similar that I have been unable to distinguish consistently the seeds of a given species when they are mixed with those of the other three.

The internal morphology of seeds was described by Martin (1946), who presented evidence from over 1200 genera, including *Phacelia,* and *Hydrophyllum.* Martin found linear and spatulate embryos in *Phacelia strictiflora* and *P. californica,* respectively, and the dwarf type in *Hydrophyllum canadense.* His study would indicate that embryo morphology does little to distinguish the Hydrophyllaceae, for the embryo types he found occur in many other families.

In the present study, the internal morphology of seeds was studied by first boiling them in 3% NaOH, removing the loosened seed coats, and sectioning by hand. In addition to revealing differences in embryo size (Fig. 2), this technique brought out interesting differences in the reaction of the seed coats.

The embryo of *Phacelia Lyallii* is comparable to the dwarf type described by Martin, and is the most distinctive type found in this group. Embryos of the other species are of the spatulate type; that of *P. linearis* being distinctive in its large size (Fig. 2-B). While the seeds of *P. procera* are consistently larger than those of the other species, the embryos are similar in size and shape. In general, embryo features do not distinguish these species as well as do seed coat details.

The boiling of seeds in 3% NaOH brought out differences in the chemical properties of the seed coats. The seeds of *Phacelia mollis* left a colorless solution, while those of all other species imparted a brown color to the NaOH solution. Seeds of *P. Lyallii* were distinctive in their sloughing, intact, the outer seed coat after this treatment. By contrast, the outer seed coat of other species came off in fragments that were often difficult to remove. The outer seed coat of *P. Franklinii* came off in large fragments, leaving a persistent, opaque inner seed coat. After the removal of the inner seed coat, the endosperm appeared translucent, and the embryo was revealed in detail. By contrast, the endosperm of all

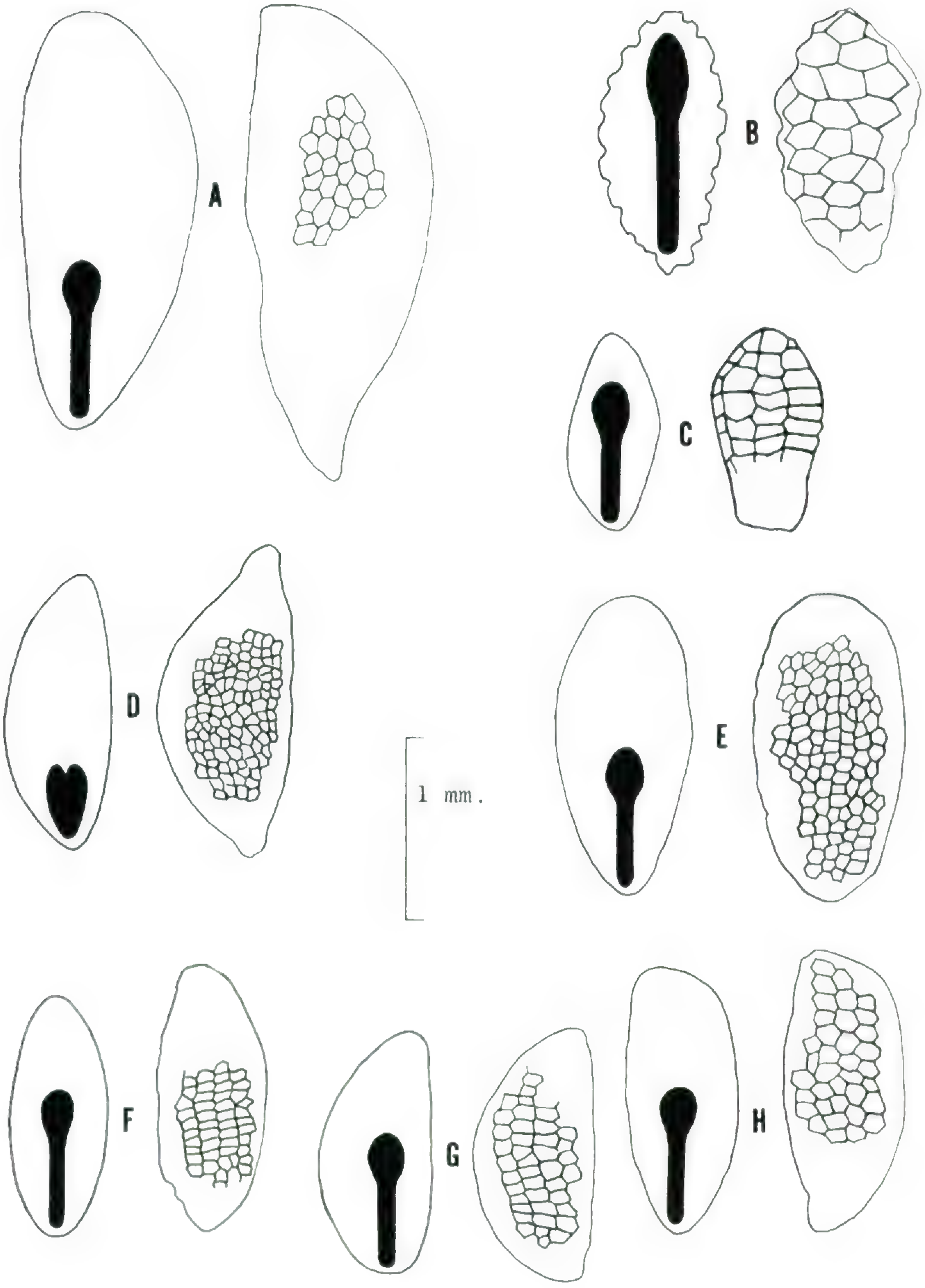


FIG. 2. Seed-coat sculpturing (right), and embryo morphology (left) in: (A) *Phacelia procera, Pollard s.n.* (CAS); (B) *P. linearis, Hedgecock s.n.* (GH); (C) *P. lenta,* TYPE; (D) *P. Lyallii, Bailey s.n.* (CAS); (E) *P. Franklinii, Langenheim 4319* (MSC); (F) *P. mollis, Scamman 6324* (GH); (G) *P. sericea* subsp. *sericea, Meyer 1080* (GH); and (H) *P. idahoensis, Gillett 1147* (MSC).

other species was opaque. A meaningful interpretation of these differences awaits a definitive histochemical study that is not within the scope of this investigation.

Trichomes. — Glandular trichomes are very common in phacelias, and were discussed by Brand in his monograph of the Hydrophyllaceae (op. cit.), and by Gillett (1955). In this study, glandular hairs (colleters) have been observed on the herbage, calyces, and (in *P. linearis*) stamen filaments. The glandular hairs that characterize a given species were drawn from the sepal margins (Fig. 3).

The multicellular head of the glandular hairs of *Phacelia procera* aids in distinguishing this species from *P. linearis,* and from all members of the *P. Franklinii* group. All other species are characterized by glandular hairs having unicellular heads. In *P. lenta,* the elongate stalk cells of the glandular hairs are a distinguishing feature.

The tapering trichomes of the *Phacelia Franklinii* group exhibit a wide range in size, an attribute Heckard (1960) has cited for the tapering trichomes in species of the *P. magellanica* complex. However, one species, *P. Lyallii,* has an indument that includes relatively large tapering trichomes, these giving a distinctive harsh texture to the herbage, in contrast to the soft-textured herbage of *P. sericea.*

The measurement of the large tapering trichomes on the calyces of *P. Lyallii* and *P. sericea* reveals a difference in trichome diameter that probably accounts for the contrast in surface texture in these species. These data are given in table 1.

The initial comparison of the stomates of *Phacelia Lyallii* and *P. sericea* indicated that there might be a gross difference in the length of the guard cells in these two species. Accordingly, 50 stomates were measured on the calyces of each species and are reported in table 1. The comparison of guard cell lengths does not reveal the significant difference that was suspected. It is nevertheless interesting to see that a great difference in trichome size and a lesser difference in guard-cell length occurs in two closely related *diploid* species.

CYTOLOGY. — The determination of chromosome numbers in both subspecies of *Phacelia sericea* was accomplished by

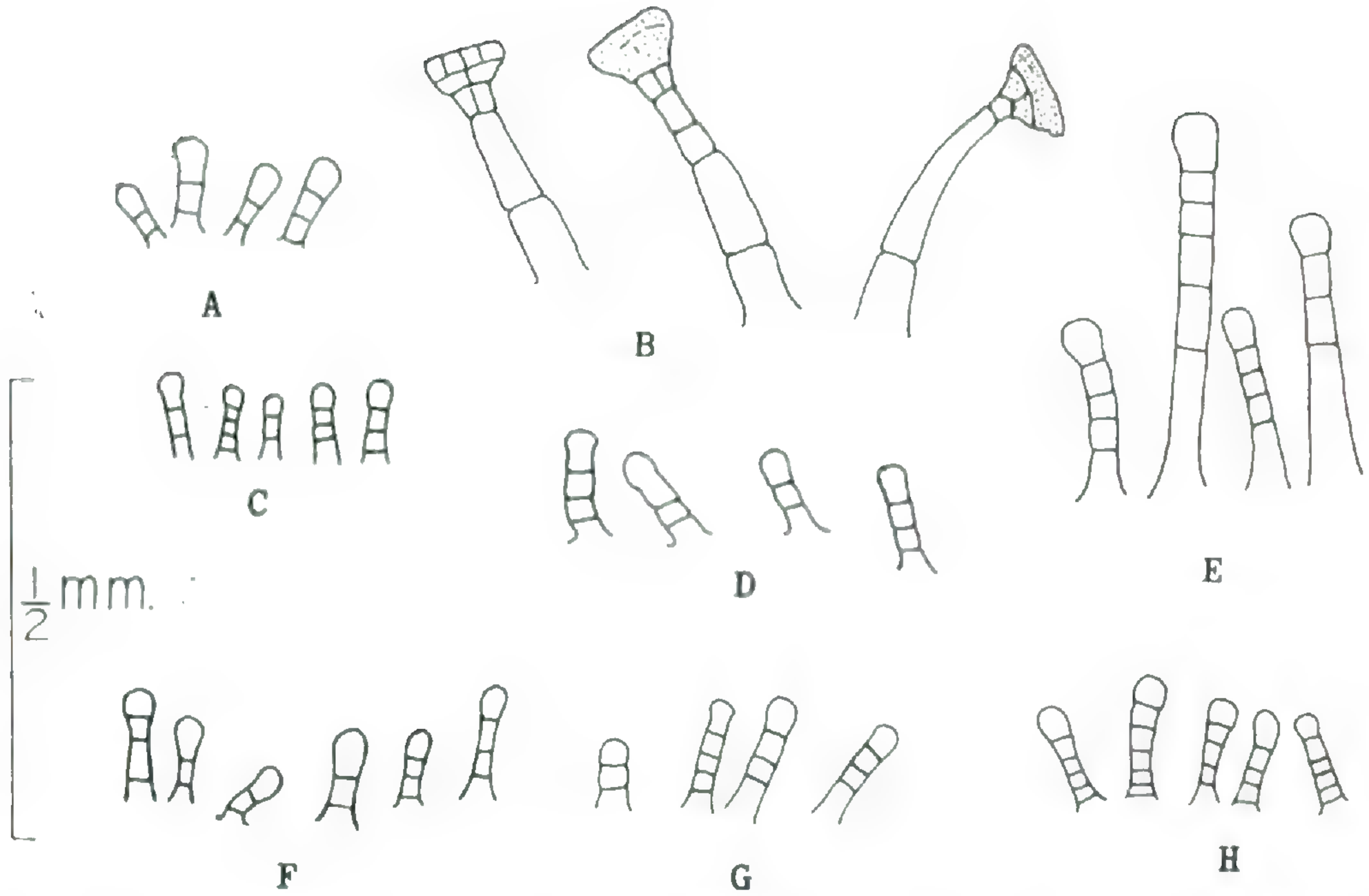


FIG. 3. Colleter types of: (A) *Phacelia Lyallii, Gillett 1151* (UC); (B) *P. procera, Richardson s.n.* (ID); (C) *P. sericea* subsp. *sericea, Gillett 1149* (MSC); (D) *P. linearis, Preece 2262* (MSC); (E) *P. lenta,* TYPE; (F) *P. idahoensis, Cronquist 2337* (GH); (G) *P. Franklinii, Raup 3020* (GH); and (H) *P. mollis, Smith 2407* (MSC).

Cave and Constance (1942, 44, 47, 50, and 59). Their counts were made of the following material:

	Chromosome No.	*Document*
Phacelia sericea subsp. *sericea*		
Montana, Glacier Co.	n = 11	*Cave 4115* (UC).
Wyoming, Albany Co.	n = 11	*Beetle 4703* (UC).
Colorado, Larimer Co.	n = 11	*Beetle 4726* (UC).
Phacelia sericea subsp. *ciliosa*		
Wyoming, Uinta Co.	n = 11	*Constance 3209* (UC).
Nevada, Elko Co.	n = 11	*Maguire & Holmgren 22303* (UC).

Chromosome counts for other species of this group were determined in the present study. These include:

Phacelia Lyallii		
Montana Glacier Co.	n = 11	*Gillett 1151* (UC).
Phacelia Franklinii		
Yukon (Teslin Lake)	n = 11	*Gillett 1185* (UC) (from *Langenheim 4319*).
Phacelia idahoensis		
Idaho, Valley Co.	n = 11	*Gillett 1147-1* (UC) (from *Hockaday s.n.* (UC).
Phacelia mollis		
Alaska (Haines)	2n = 22	*Rude s.n.* (MSC)

The uniform occurrence of eleven pairs of chromosomes by no means distinguishes the *Phacelia Franklinii* group

from other phacelias. Cave and Constance (op. cit.) have found this chromosome number in no less than 75 species, these representing five of Brand's six sections.

TABLE 1. Size comparisons of guard cells and large trichomes on sepals of *Phacelia sericea* subsp. *sericea*[1] and *P. Lyallii*[2].

		MICRONS		
	No. Measured	*Min.*	*Median*	*Max.*
Guard Cell Length				
P. sericea subsp. *sericea*	50	23	28	39
P. Lyallii	50	26	36	42
Trichome Diameter (Basal)				
P. sericea subsp. *sericea*	50	27	35	50
P. Lyallii	50	50	62	95

[1]*Gillett 1162-1* (MSC).
[2]*Gillett 1151* (UC).

TAXONOMIC TREATMENT

The *Phacelia Franklinii* group: — Erect annuals, biennials, or perennials forming leaf rosettes upon germination; an inflorescence axis arising from the center of the leaf rosette, bearing a congested, terminal, virgate or spreading inflorescence; corolla tube with overlapping, near-parallel corolla scales covering a nectary at the base of each petal, each scale adnate along one edge to a lateral vein, the free edge overlying the midvein; capsule with 10-60 reticulately pitted seeds.

Species 6, northern Arizona to Great Bear Lake, Canada.

KEY TO THE SPECIES

Annuals or biennials with hairy filaments; inner surface of corolla glabrous; up to 40-60 seeds per capsule ..... 1. *P. Franklinii.*
Perennials with glabrous filaments; inner surface of the corolla pubescent; 10-40 seeds per capsule.
Plants glandular; restricted to south-central Washington ..... 2. *P. lenta.*
Plants not glandular.
Hairs coarse, giving a rough strigose texture to herbage; inflorescence non-virgate; restricted alpine ..... 3. *P. Lyallii.*
Hairs fine, giving a soft texture to herbage; inflorescence virgate.
Pubescence of spreading hairs, giving a velutinous herbage; Alaska & Yukon ..... 4. *P. mollis.*
Pubescence of appressed hairs; herbage glabrate to sericeous; northern Arizona to central British Columbia.
Leaves coarsely lobed, glabrate; corollas urceolate; stamens ca. 1¼ length of corolla; central Idaho ..... 5. *P. idahoensis.*
Leaves with broad to narrow lobes, light to densely sericeous; corollas urceolate-campanulate to campanulate; stamens 1¼ -

3 times length of corolla; Arizona to British Columbia ..... 6. *P. sericea.*

Stamens 2 - 3 times length of corolla; corollas campanulate; leaves with narrow lobes, sericeous to densely sericeous ..... 6-A. subsp. *sericea.*

Stamens 1¼ - 2 times length of corolla; corollas urceolate-campanulate; leaves with broad lobes; light-sericeous ..... 6-B. subsp. *ciliosa.*

1. **Phacelia Franklinii** (R. Br.) A. Gray, Man. Bot. ed. 2, 329. 1856.

Eutoca Franklinii R. Brown in Richards. Bot. App. Franklin Journey 764, t. 27. 1823. Bot. Mag. **57**:pl. 2985. 1830.

Annual or biennial 1-10 dm tall, with pubescence of straight, simple hairs and interspersed glandular hairs; initial vegetative axis 1-3 cm long; one or more leafy aerial branches arising from the rosette and terminated by inflorescences; leaves 5-15 cm long, the petioles 1-4 cm; blades lanceolate to ovate, pinnatifid to pinnate, the linear to ovate divisions entire to coarsely toothed to deeply lobed; branches terminated by smaller laterals, each bearing one or two cymes up to 15 cm. long; flowers on stout, glandular pedicels 1-2 mm long; the linear calyces 5-10 mm long, equal to the mature capsule; corolla deciduous, 10-15 mm long, campanulate, divided nearly one-half its length into tapering, rounded, violet, lavender, or white lobes, inner surface glabrous; tube white, stamens equal to corolla, the filaments with numerous to few tapering, contorted hairs on upper portion, with few short, erect hairs at bases; style equal to filaments, cleft about one-third its length, with glandular and non-glandular hairs on lower portion; capsule 5-10 mm long, acute; seeds 40-60, black, ca. 1.5 mm long.

TYPE AREA: Churchill River, northern Saskatchewan (Richardson, 1st Franklin Exped.).

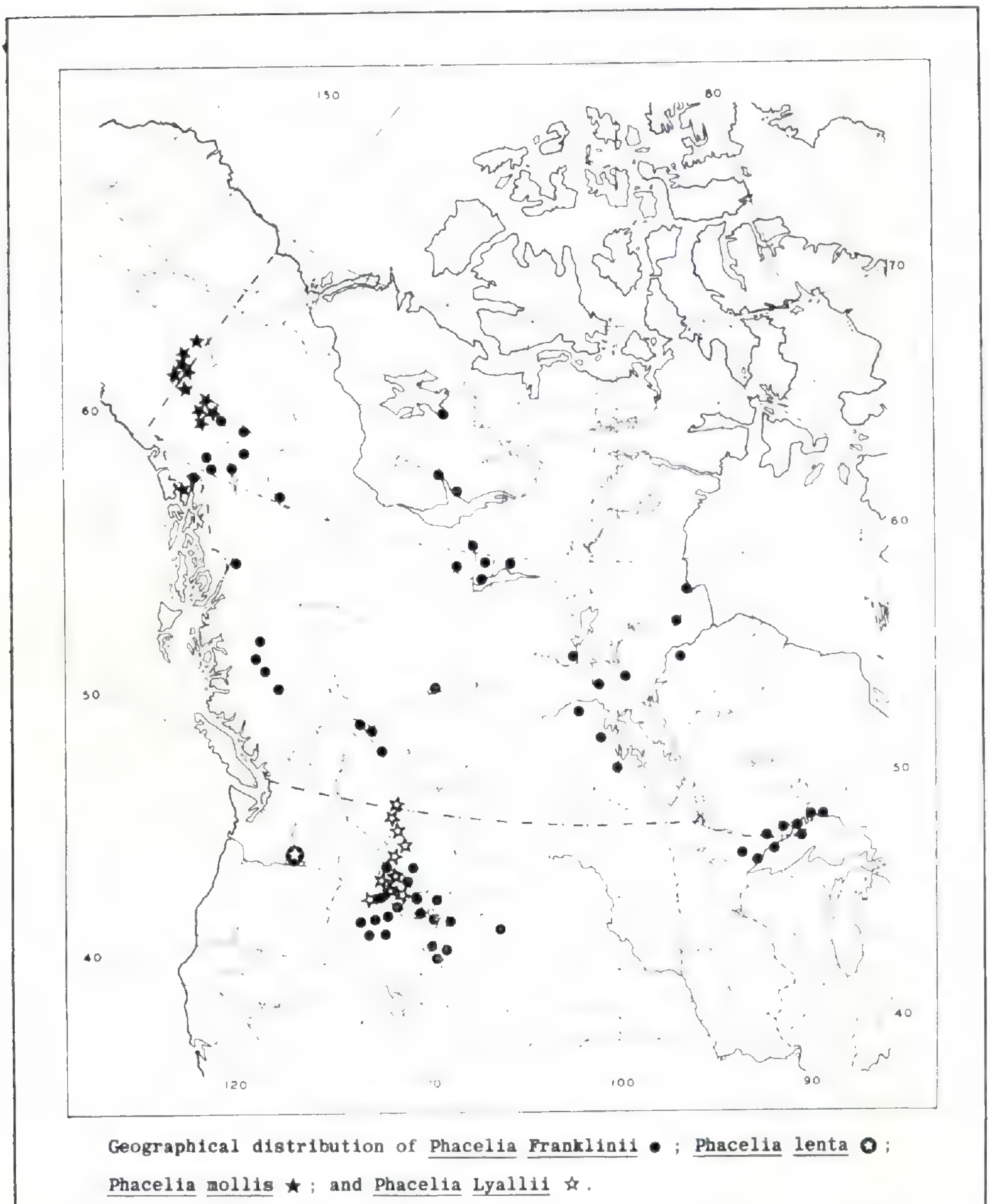
RANGE: Wyoming, northwest to the central Yukon and Great Bear Lake, east to Hudson Bay and the north shore of Lake Superior, sea level to 8,000 feet (Fig. 4).

Phacelia Franklinii is perhaps the most widely distributed species in the genus. It remains relatively uniform throughout its range, with slight variations in flower color and in frequency of filament hairs.

A close relationship between *Phacelia Franklinii* and *P. linearis* has been postulated by Gray (1875), and Howell (1945). However, a point-by-point comparison of these two species in terms of corolla morphology, pubescence of filaments, seed-coat sculpturing, and embryo structure (Figs. 1 & 2) reveals conspicuous qualitative differences that suggest a distant, rather than a close relationship. Furthermore, *P. linearis* is a strict annual, while *P. Franklinii* demonstrates the biennial as well as the annual duration. Finally, numer-

ous reciprocal cross-pollinations between greenhouse plants of *P. Franklinii (Gillett 1185* (UC)*)* and *P. linearis (Preece 2262* (MSC)*)* all failed to produce seed.

MACKENZIE DISTRICT: Great Bear Lake, *Porsild 3707* (CAN). YUKON: Lewes River, 62°, *Ogilvie 17012* (CAN); Mile-Post 841, Alaska Highway, *Langenheim 4319* (UC, MSC). ALASKA: Skagway, *Eyerdam 3334* (UC). BRITISH COLUMBIA: Iskut River, *Preble & Mixter 604* (US); Redstone, *Eastham 12285* (UBC, UC, WS, CAN). ALBERTA: Athabasca Lake, *Raup & Abbe 4479* (CAN, GH); Pyramid Lake, Jasper Park, *Scamman*



Geographical distribution of Phacelia Franklinii ● ; Phacelia lenta ✪ ; Phacelia mollis ★ ; and Phacelia Lyallii ☆ .

FIG. 4. Geographical distribution of *Phacelia Franklinii, P. lenta, P. mollis,* and *P. Lyallii.*

3019 (GH, US). SASKATCHEWAN: Hudson Bay Junction, *Breitung 1003* (CAN, UC). MANITOBA: Churchill, *Gardner 89* (CAN); Riding Mountains, *Halliday s.n.* (CAN). ONTARIO: Nipigon River, *Macoun s.n.* (CAN). MINNESOTA: Cook Co.: Mountain Lake, *Butters et al. 118* (GH, US, MIN). MICHIGAN: Isle Royal, Rock Harbor Light, *Cooper 96* (MIN). IDAHO: Custer Co.: Mackay, *Nelson & Macbride 1468* (CAN, GH, MIN, RM, US, WS, UC). MONTANA: Beaverhead Co.: Wisdom, *Hitchcock & Muhlick 12594* (UC, GH, US, RM, WS, CAN, PH). WYOMING: Sublette Co.: Green River Lakes, *Porter 5551* (CAS, UC, PH, US, RM, GH); Washakie Co.: Ten Sleep Canyon, *Nelson & Nelson 1097* (UC, WS, PH, US, RM).

2. **Phacelia lenta** Piper. Bull. Tor. Bot. Club. 28:44. 1901.

Glandular perennial; 1-1.5 dm tall; leaves 1.5-6 cm. long, the lower long-petiolate, the upper sub-sessile, blades oblong-elliptic and pinnatifid, the 5-9 divisions cleft into 2-5 lobes; inflorescence 3-7 cm long, with ascending cymes, the flowers with pedicels 1-3 mm long; calyces glandular, linear-lanceolate, 4-6 mm long; corolla persistent, white, 6-8 mm long and cleft 1/3 its length into rounded lobes, inner surface pubescent; stamens 15-20 mm long, with glabrous filaments; style equal to stamens, cleft 1/4 its length; capsule equal to ensheathing corolla; seeds, 15-20, black, ca. 1 mm long.

TYPE: "Bare hills of Columbia River, Washington Territory, May, 1883". *T.S. Brandegee 976* (GH!) Isotypes (CAN! UC!).

This species is known only from the type collection, and may possibly be extinct. The distinctive seeds and colleters (Figs. 2, 3), and restricted distribution indicate that Piper was correct in giving this material specific rank. It is by no means an aberrant form of *P. sericea* as suggested by Brand (1913).

Piper (1906) cites *Brandegee 975 (Phacelia ramosissima)*, from Priest Rapids, on the Columbia; and *Brandegee 978 (Nama parviflorum)* collected near Wallula, about 75 miles downstream. The type collection of *P. lenta*, therefore, may have been obtained between these points.

3. **Phacelia Lyallii** (A. Gray) Rydberg. Mem. N.Y. Bot. Gard. 1: 325. 1900.

Phacelia sericea (Graham) A. Gray var. *Lyallii* A. Gray. Proc. Am. Acad. **10**: 323. 1875.

Phacelia sericea subsp. *Lyallii* (A. Gray) Brand *in* Engler, Pflanzenreich 4^{251}: 107. 1913.

Variously branched, strigose-pubescent perennial; lower branches frequently rhizomatous in talus plants; leaves 2-12 cm long, lamina lanceolate to ovate, coarsely dentate to pinnatifid; lower leaves long-petiolate, upper leaves sessile; leafy inflorescence axis terminating in a single helicoid cyme, or in several near equal branches each bearing

1-2 cymes; calyces linear, 3-8 mm long; corolla deciduous, 5-8 mm long, purple to lavender, rarely white, open-campanulate, cleft about 1/3 its length into rounded lobes, pubescent on inner surface; stamens exserted up to twice the length of corolla, the filaments glabrous; style nearly equal to stamens, cleft 1/4 to 1/3 its length; capsule 5-8 mm long, with acute tip, seeds 12-20, black, ca. 1.5 mm long.

TYPE: "Rocky Mts. Lat 49° N. Alt. 6-7000 ft. above the sea. 1861." *Lyall s.n.* (GH!)

RANGE: Restricted to talus banks and rock crevices on and near summits of the northern Rocky Mountains, 5,000-11,000 feet, southwestern Montana to southern Alberta (Fig. 4).

This species is sympatric with *Phacelia sericea* subsp. *sericea* in Glacier National Park, Montana, where distinctive plants of each occur within a few feet of each other. The two species are similar in leaf shape and in corolla morphology (Fig. 1); but are quite different in seed and embryo features (Fig. 2), as well as in the size of non-glandular hairs.

The crisp, fleshy leaves of plants in the natural habitat (Logan Pass, Montana) are very probably a result of environmental modification, for greenhouse plants of the same race produced pliable, non-fleshy leaves.

ALBERTA: Waterton Lakes National Park: Lower Carthew Lake, *Hitchcock & Martin 18438* (GH, WS, UC). MONTANA: Glacier Co.: Grinnell Lake, *Hitchcock 1988* (NY). Flathead Co.: Gordon Mountain, *Hitchcock 18882* (RM, UC, WS, NY, COLO, ID). Beaverhead Co.: Lake Waukena, *Hitchcock & Muhlick 13060* (GH, RM, UC, WS, NY, CAS, CAN). IDAHO: Lemhi Co.: Bitter Root Range, *Kirtley s.n.* (WS); Mill Creek, Salmon River Mts., *Henderson 3945* (RM).

4. **Phacelia mollis** Macbride. Contr. Gray Herb. 49: 39. 1917.

Velutinous perennial 1-6 dm tall; pubescence of long, spreading, often twisted, non-glandular hairs, and interspersed short glandular hairs; vegetative axis very short, bearing numerous leaves, 1-25 cm long, petiolate; lamina lanceolate, 1-15 cm long, coarsely toothed to lobed to pinnatifid, the divisions entire or with 1-3 shallow clefts; inflorescence virgate, the stout axis with few sessile leaves below; bearing slender, leafless branches up to 15 cm long, each branch giving rise to 1-7 helicoid cymes 1-3 cm long; flowers on slender pedicels 1-5 mm long; calyces linear, 4-8 mm long; corolla deciduous, campanulate, 5-10 mm long, cleft about 1/3 its length into rounded lobes; stamens about twice the length of corolla, inserted slightly above base of tube, the filaments glabrous, bases free of corolla scales; style equal to stamens, cleft from 1/5 to 1/4 its length; capsule 5-10 mm long, the beak acute to acuminate; seeds 20-35, black, ca. 1.5 mm long.

TYPE: Coffee Creek, Yukon Territory *Eastwood 551-a* (US!) Isotype (CAS!)

RANGE: Dawson Range, Alaska and Yukon Territory, with outlying population near Haines, Alaska; sea level to 5500 feet (Fig. 4).

This species occurs on exposed sites, the soil often gravelly, between 60° and 64° north latitude.

Greenhouse plants of *Phacelia mollis* produced vigorous growth only after the use of distilled water and frequent dosages of iron sulfate. These cultural requirements, not necessary for the other species, would suggest that the restricted distribution of *P. mollis* could be due, in part, to specific soil requirements.

ALASKA: Chicken, *Smith 2407* (MSC, UC); Milepost 1260, Alaska Highway, *Williams s.n.* (S); Klukwan, *Anderson 2196* (NY). YUKON: Klotassin, *Cairnes s.n.* (CAN, NY); Dawson Range, *Bostock 10* (CAN); Selwyn River, *Tarleton 145* (US); Ladue Valley, *Eaton s.n.* (US).

5. **Phacelia idahoensis** Henderson. Bull. Torr. Bot. Club. 22:48. 1895.

Phacelia sericea subsp. *idahoensis* (Henderson) Brand *in* Engler, Pflanzenreich 4^{251}: 107. 1913.

Glabrate perennial with pubescence of scattered, appressed hairs, and few interspersed colleters; vegetative axis from 2-5 cm long, often branched; the floriferous meristem arising directly from the leaf rosette and elevated by sub-terminal growth to form a virgate, fistulose inflorescence axis; basal leaves up to 20 cm long, with petioles equal to or shorter than the lamina, the upper leaves progressively shorter-petiolate to sessile-bracteate; lamina lanceolate to ovate, entire to cleft to pinnatifid to lobed, the primary divisions up to 1 cm broad, these entire or cleft into 2-3 lobes; inflorescence axis up to 1.5 m high, leafy below; the terminal floriferous portion up to 4 dm long; the axis giving rise to small branches 5-15 mm long, each bearing a pair of helicoid cymes 5-15 mm long, each with 2-7 flowers on slender pedicels 2-5 mm long; calyces linear, 3-5 mm long; corolla persistent, 4-6 mm long, urceolate, white to light purple, cleft 1/4 to 1/3 its length into rounded lobes, inner surface pubescent between lateral traces of each lobe; the tube strongly dilated between the lateral traces of each lobe to form 5 gibbous nectaries, each nectary covered by a pair of overlapping, parallel corolla scales; stamens with glabrous filaments ca. 1 1/4 length of corolla, the bases free of corolla scales; style included to exserted up to 5 mm above corolla, cleft 1/5 to 1/3 its length; capsule equal to and ensheathed by the marcescent corolla, the beak short-acuminate; seeds 20-30, black, 1-2 mm long.

TYPE: Craig Mts., Nez Perce Co., Idaho. *Henderson 2770* (US). Isotypes (RM! MSC! WS (incl. photo of type)!)

RANGE: Central Idaho, in wet meadows, streambanks, and partially-flooded areas, 2800 to 7000 feet (Fig. 5).

Its unique floral morphology and restriction to wet habitats within a relatively limited geographical area, make

Phacelia idahoensis an easily recognized species. It is relatively uniform throughout its range in contrast to extensive variation found in the closely related *P. sericea.*

IDAHO: Latah Co.: Boville, *Piper 2902* (GH, WS). Shoshone Co.: Cranberry Creek, *Sharsmith 3586* (RM, GH, CAS, UC, WS). Idaho Co.: Orogrande, *Leiberg 1024* (UC, RM, GH, CAS). Valley Co.: Warm Lake, *Hitchcock & Muhlick 14022* (RM, UC, WS, CAS). Custer Co.: Stanley, *Hitchcock 19182* (CAN, WS, UC, RM, COLO, ID). Boise Co.: Beaver Creek, *Hitchcock & Muhlick 9983* (UC, WS).

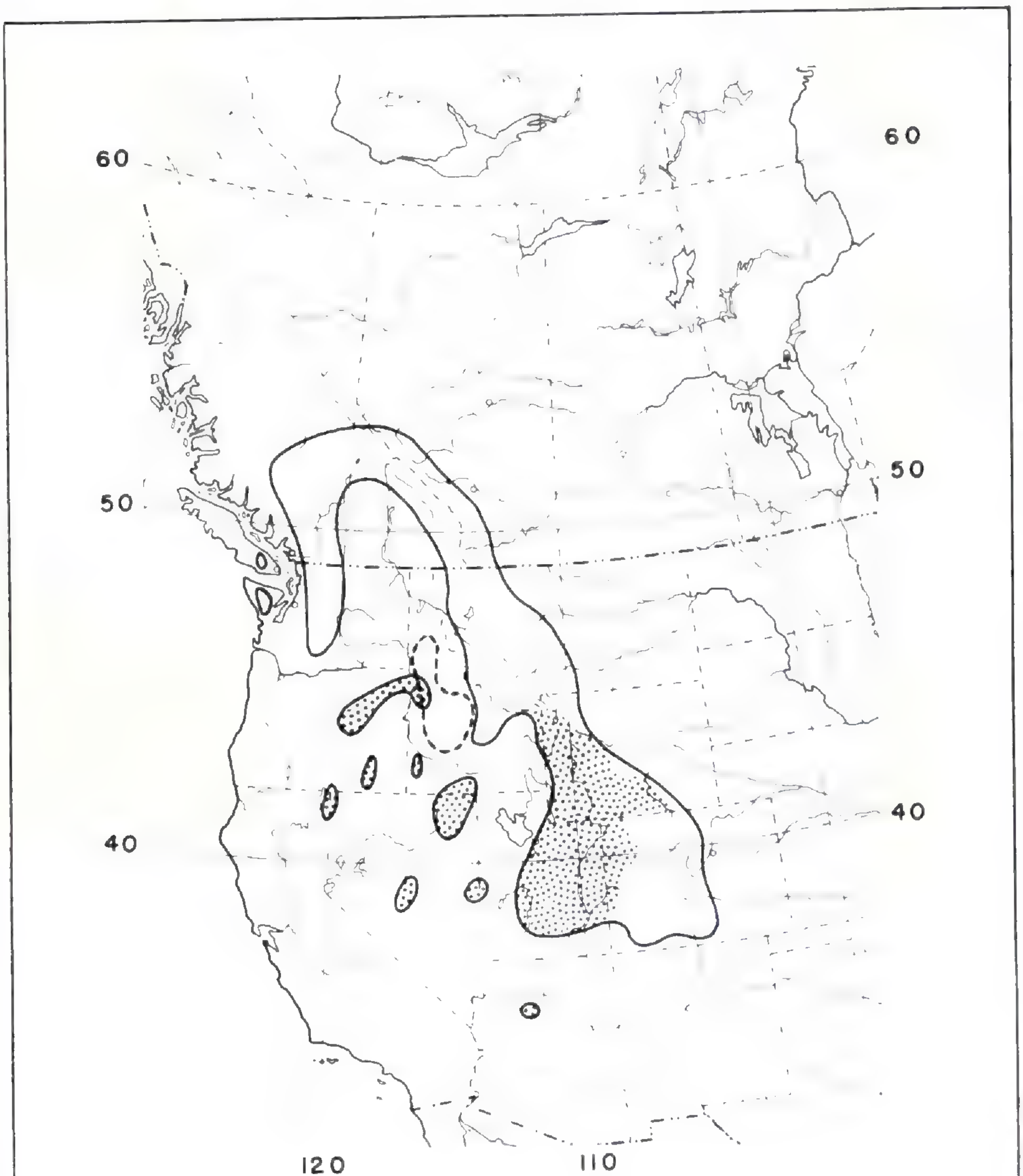


FIG. 5. Geographical distribution of *Phacelia idahoensis* and *P. sericea.*

6. **Phacelia sericea** (Graham) A. Gray. Amer. Journ. Sci. II. **34**: 254. 1862.

Eutoca sericea Graham. Edinburgh N. Phil. Journ. 172. 1830. Bot. Mag. **57**: pl. 3003. 1830.

Sericeous perennial up to 0.6 m tall with pubescence of numerous fine, appressed hairs and interspersed colleters; vegetative axis from 2-5 cm long, often branched; the floriferous meristem arising directly from the leaf rosette and elevated by sub-terminal growth to form a virgate fistulose inflorescence axis; basal leaves up to 20 cm long, with petioles equal to or shorter than the lamina, the upper leaves progressively shorter-petiolate to sessile-bracteate; lamina lanceolate to ovate, cleft to pinnatifid to lobed, the primary divisions 1-10 mm broad, entire or cleft into 2-5 narrow lobes; inflorescence axis up to 0.6 m high, leafy below; the terminal floriferous portion up to 2.5 dm long; the axis giving rise to small branches 5-15 mm long, each branch bearing one or two helicoid cymes up to 3 cm long, each bearing from 2-7 flowers on slender pedicels 2-5 mm long; calyces linear, 5-7 mm long; corolla persistent, 5-8 mm long, urceolate-campanulate to campanulate, light to dark purple, cleft 1/3 to 1/2 its length into rounded lobes, inner surface pubescent between lateral traces of each lobe; the tube dilated to slightly concave between lateral traces of each lobe to form 5 nectaries; each nectary covered by a pair of overlapping, parallel scales; stamens with glabrous filaments ca. 1 1/4-3 times length of corolla, the bases free of corolla scales; style slightly shorter, equal to, or longer than stamens, cleft 1/5 to 1/3 its length; capsule equal to and ensheathed by the marcescent corolla, the beak acuminate; seeds 20-40, black, 1-2 mm long.

6-A. **Phacelia sericea** subsp. **sericea.**

Phacelia sericea (Graham) A. Gray subsp. *eu-sericea* var. *caespitosa* Brand *in* Pflanzenreich 4^{251}: 107. 1913.

Dense to matted-sericeous plants up to 0.5 m tall; basal and upper leaves cleft to pinnatifid to lobed, the divisions 1-5 mm broad; cymes congested on inflorescence axis; corollas campanulate with shallow nectaries, stamens 2-3 times the length of corolla.

TYPE AREA: Canadian Rockies (Drummond, 2nd Franklin Exped.).

RANGE: Rocky Mountains, Cascades, and Olympic Range, 4500 to 13000 feet (Fig. 5).

This subspecies occurs on a wide variety of montane habitats, very frequently above timberline. Populations in the Cascade Mountains, the Olympic Range and the far-northern Rockies are restricted to alpine habitats; and this habitat restriction is correlated with a generally uniform flower shape (campanulate), pubescence (matted-sericeous), and leaf-cutting (narrow lobes). Plants of the northern, central, and southern Rocky Mountains occur on sub-alpine to alpine habitats, and demonstrate much greater variability in these

three features, portraying a gradual intergradation of subsp. *sericea* with subsp. *ciliosa*. In central Wyoming, this intergradation can be seen in plants of the same population.

WASHINGTON: Callam Co.: Obstruction Point Ridge, *Meyer 1234* (UC, COLO, WS, GH). Okanogan Co.: Harts Pass, *Kruckeberg 2678* (RM, WS, CAN, ID, UC, COLO). BRITISH COLUMBIA: Natal, *Weber 2286* (COLO, UC, WS, RM, GH). ALBERTA: Pincher Creek, *Moss 805* (GH, UC). MONTANA: Lake Co.: McDonald Lake, *Hitchcock 18215* (CAS, WS, RM, UC, ID, COLO). Park Co.: Silver Pass, *Hitchcock 16415* (COLO, RM, GH, UC, WS). IDAHO: Blaine Co.: Norton Peak, *Hitchcock & Muhlick 10683* (CAN, RM, UC, WS, GH, CAS). WYOMING: Park Co.: Sylvan Pass, *Gillett 1149* (MSC, UC). Albany Co.: Woods Creek, *Goodding 1434* (UC, COLO, RM, GH). COLORADO: Clear Creek Co. Loveland Pass, *Robbins 738* (COLO, UC, GH). Hinsdale Co.: Carson, *Baker 304* (GH, CAS, UC, WS, RM). La Plata Co.: La Plata, *Baker 520* (GH, CAS, UC, RM). Mineral Co.: Wolf Creek Pass, *Beaman 1128* (MSC).

6-B. **Phacelia sericea** subsp. **ciliosa** (Rydb.) stat. nov.

Phacelia sericea var. *ciliosa* Rydberg. Bull. Tor. Bot. Club **31**: 636. 1904.

Phacelia sericea (Graham) A. Gray subsp. *eu-sericea* var. *biennis* (A. Nelson) Brand *in* Engler, Pflanzenreich 4^{251}: 107. 1913. (As to name only).

Phacelia sericea (Graham) A. Gray subsp. *eu-sericea* var. *Nelsoni* Brand. op. cit. 107. 1913.

Glabrate to sericeous plants up to 0.6 m tall; basal and upper leaves cleft to pinnatifid to lobed, the divisions 3-10 mm broad; cymes congested to sparsely distributed on inflorescence axis; corollas urceolate-campanulate, with slightly gibbous nectaries; stamens 1 1/4-2 times length of corolla.

TYPE: North of Meeker, Rio Blanco Co., Colorado. *Osterhout 2619* (NY!). Isotype (RM!).

RANGE: Isolated mountain ranges, Wallowa Mts., Oregon to San Francisco Peaks, Arizona; and Warner Mts., California to Laramie Mts., Wyoming; 6,000 to 11,500 feet (Fig. 5).

This subspecies includes material that portrays a very broad spectrum of variation. This variation is quantitative, and is conspicuously expressed by the amount of pubescence, the width of leaf lobes, and the shape of the corolla (cf. Gillett, In Press). One extreme of this variation is portrayed by specimens that show a resemblance to *Phacelia idahoensis*. At the other extreme, specimens bear a very marked resemblance to *P. sericea* subsp. *sericea*. Because of the gradual intergradation between this material and the sympatric *P. sericea* subsp. *sericea*, this assemblage of intermediate forms is considered best aligned with *P. sericea*

rather than *P. idahoensis*.

OREGON: Baker Co.: Anthony Lakes, *Hitchcock 19702* (MONTU, UC, RM, ID, WS, CAS). Wallowa Co.: Aneroid Lake, *Kruckeberg 3141* (WS, ID, UC, RM, CAS, MONTU). Harney Co.: Steens Mts., *Thompson 12134* (UC, CAS, GH). IDAHO: Idaho Co.: Heavens Gate, *Jones 193* (ID, WS, GH). OWYHEE CO.: Silver City, *Macbride 901* (CAN, GH, ID, WS, RM, UC). CALIFORNIA: Modoc Co.: Head of Eagle Creek, *Alexander & Kellogg 5090* (UC, GH). NEVADA: Elko Co.: Jarbidge, *Nelson & Macbride 1929* (RM, MONTU, ID, UC, GH). Nye Co.: Mohawk R. S., *Linsdale 217* (CAS). White Pine Co.: Lehman Basin, *Maguire 21130* (UC, CAS). UTAH: Uintah Co.: Vernal, *Porter & Rollins 5631* (GH, RM, UC). San Juan Co.: Abajo Mts., *Goodman & Hitchcock 1380* (RM, MONTU, CAS, GH, UC). WYOMING: Uinta Co.: Evanston, *Rollins 2346* (GH, UC). Sublette Co.: Green River Lakes, *Porter 5508* (GH, CAS, RM). Albany Co.: Woods Creek, *Goodding 1434* (GH, UC). COLORADO: Moffatt Co.: Cold Spring Mt., *Porter 3928* (RM, GH). ARIZONA: Coconino Co.: Near Flagstaff, *Purpus s.n.* (UC). — DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, MICHIGAN STATE UNIVERSITY.

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HEPATICA IN NORTH AMERICA

JULIAN A. STEYERMARK AND CORA S. STEYERMARK

For many years North American botanists have accepted the maintenance of two species of *Hepatica* in the United States and Canada, *H. acutiloba* DC. and *H. americana* (DC.) Ker. This division into distinct specific taxa has been continued in the current eighth edition of Gray's Manual. However, Gleason, in the New Illustrated Flora (vol. 2: 183. 1952) has questioned the soundness of the recognition of *H. americana* as a species distinct from *H. nobilis* Schreb. of Europe, noting that "The difference between our plant and the European *H. nobilis* Schreb. is slight and scarcely warrants specific segregation." It is the purpose of the present paper to provide further support of Gleason's suggestion, and to bring evidence to indicate that the american taxa of *Hepatica* are better considered as varieties of the European *H. nobilis*.

PRELIMINARY OBSERVATIONS

North American *Hepaticas* fall naturally into two taxa, 1) those with rounded lobes of the leaf-blades, and 2) those with acute or acutish lobes. These obvious differences have been the chief criteria used to distinguish the taxa specifically. Over most of the North American range of the genus, the two taxa occupy usually separate and distinct habitats, the populations of the two taxa maintaining themselves rather uniformly, not only ecologically but also geographically. In Missouri, for example, *H. acutiloba* DC. occupies the more neutral to calcareous soils, *H. americana* the more acid soils, and *H. acutiloba* occupies glaciated northern Missouri extending west in that sector to Mercer and Sullivan counties, whereas *H. americana* is restricted to unglaciated Ozarkian southern Missouri. The ranges of the two taxa in Missouri are fairly sharp, but at their zones of overlap geographically and ecologically intergrading specimens of hybrid origin are encountered (Fig. 1). In northern Illinois, where the margins of the ranges also overlap, intermediate types are found which are impossible to assign to one or the other of the two taxa.

The problem of the recognition of the two taxa as distinct

species presented itself to the present authors in 1943. Both "species" occurred by the thousands on the forested morainal slopes and crests of the ravines of the Valparaiso Moraine in the area where the authors lived in the Biltmore subdivision of Barrington, Lake County, northern Illinois. The opportunity of intensive study of this problem was offered the junior author, who intensively surveyed the living flowering plants throughout a three-mile length of the stream

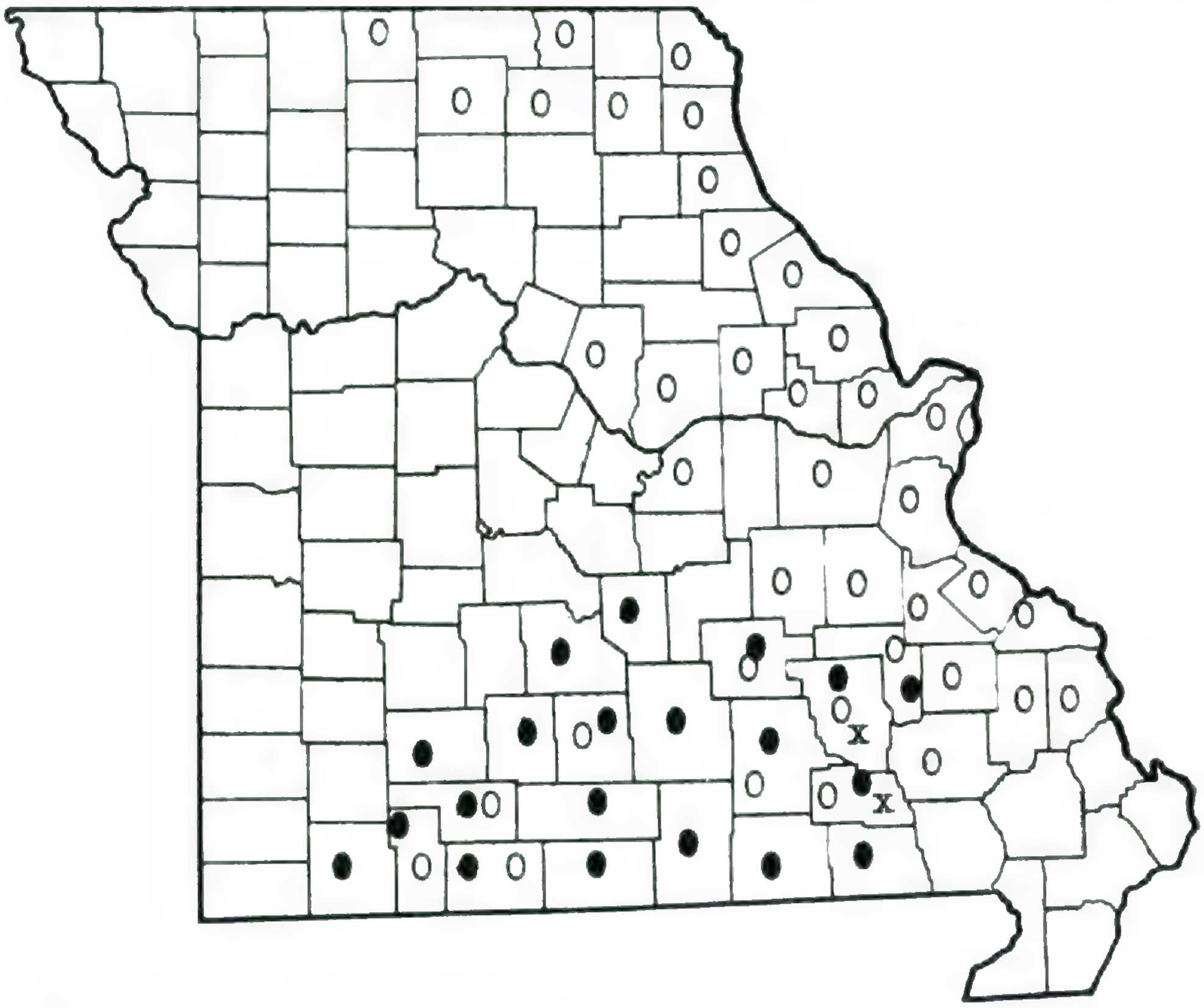

FIG. 1. Distribution of *Hepatica* in Missouri. Solid oval — *H. nobilis* var. *obtusa*. Open oval — *H. nobilis* var. *acuta*. × — putative hybrid populations.

following Eton Drive in the wooded section of Biltmore subdivision. In this area *H. americana* occurred on the more acid, leached soils on top of the ravines and slopes, whereas *H. acutiloba* was encountered most frequently in the richer and more neutral soil of the creek bottom and ascended to nearly three-fourths the distance up the slope. A zone of overlap existed in the upper portion of the slope where the two types met. Study of all the plants in this extensive area, based upon apex of leaf-blades and involucre, revealed an intergradation of the two taxa, showing the following results: 35% pure *H. americana*, 15% pure *H. acutiloba*, with

the remaining 50% somewhere between the two and often too puzzling to determine as one or the other "species." No additional facts could be obtained from study of the color, number, length, or width of the sepals. Their color varied from pale lavender to deep purple in 90% of the plants examined, pale pink to deep rose in about 5% of the cases, and white in another 5%. Both taxa exhibited approximately the same percentage differences. Moreover, no distinction could be found among either *H. acutiloba* or *H. americana* in color variation nor in their occurrence on any particular exposure of slope.

Measurements of involucre and sepals of living plants from the above area revealed the following: *Sepal length:* 9-13 mm. long in *H. americana*, averaging 11.6 mm.; 10-15 mm. long in *H. acutiloba*, averaging 11.75 mm.; 11-14 mm. long in the intermediate types, averaging 12.05 mm. *Sepal width:* 5.5-8 mm. wide in *H. americana*, averaging 6.5 mm.; 4-8 mm. wide in *H. acutiloba*, averaging 6.75 mm.; 5.5-10 mm. wide in the intermediate types, averaging 7.15 mm. *Involucre length:* 9-17 mm. long in *H. americana*, averaging 12.3 mm.; 7-18 mm. long in *H. acutiloba*, averaging 11.4 mm.; 9-14 mm. long in the intermediate types, averaging 11.4 mm. *Involucre width:* 7.5-9 mm. wide in *H. americana*, averaging 7.25 mm.; 4-9 mm. wide in *H. acutiloba*, averaging 5.95 mm.; 4.5-9 mm. wide in the intermediate types, averaging 6.65 mm. The averages of these measurements are summarized as follows:

	H. americana	*H. acutiloba*	*Intermediate*
Sepal length	11.6	11.75	12.05
Sepal width	6.5	6.75	7.15
Involucre length	12.3	11.4	11.4
Involucre width	7.25	5.95	6.65

Preliminary cytological studies conducted by Dr. O. J. Eigsti and Dr. Albert S. Rouffa revealed no conclusive differences between the two taxa.

STUDY OF HERBARIUM MATERIAL

In order to determine the relationship of North American *Hepatica* to other taxa of the genus, especially those involving the closely related *Hepatica nobilis*, specimens were studied by the senior author from the following herbaria: Chicago Natural History Museum, Gray Herbarium of Har-

vard University, Missouri Botanical Garden, and United States National Herbarium. To the curators of these institutions the senior author is deeply grateful for the privilege of studying this material. Criteria used for study involved length and pubescence of petioles, length and width of involucre and sepals, relative pubescence of leaf-blades and involucre, and shape and pubescence of achenes. Specimens of *Hepatica* from North America were compared with those from Europe and eastern Asia.

In Europe *Hepatica nobilis* consists of two main variations, (1) the more common type, with the lobes of the leaf-blades usually acute or short-pointed or acutish, and (2) a less frequent type, with the lobes of the leaf-blades usually rounded. The historical type is based upon the variation with acutish lobes and is the same as *Anemone Hepatica* L. var. *typica* (Beck) Gürke, *A. Hepatica* var. *acutiuscula* Pritzel, and *H. nobilis* var. *typica* Beck; the round-lobed variation is synonymous with *Anemone Hepatica* var. *rotundata* (Schur.) Gürke and *H. nobilis* var. *rotundata* (Schur.) Domin & Krajina. Since European authors are not in complete agreement as to whether such variations are forms or varieties of *Hepatica nobilis*, references to the European variations are indicated in the discussion below as round-lobed European *H. nobilis* and acute-lobed European *H. nobilis*.

Leaf-blade. Among the European collections of *H. nobilis* examined, about an equal number were either round-lobed or acute-lobed. Among the latter, a number of specimens are on the border line and have an appearance intermediate in aspect between *H. acutiloba* and *H. americana*. Among the round-lobed leaf-blades of the European *H. nobilis* are also a number of border line cases which exhibit a slight acuteness of the lobes. In some specimens, both types of leaf-lobes appeared on the same sheet (herb. *J. S. Mill*, May, 1839, Austria, in Gray Herbarium).

In general, the lobes of the leaf-blades of the American plants of *Hepatica* are sufficiently well-differentiated to enable one to distinguish two types (1) those with the lobes rounded at the summit and usually broader than long, the length of the leaf-blade being about two times the distance

from the base of the sinuses to the summit of the petiole, the usually accepted characteristics of *H. americana*, and (2) those with the lobes acute or acutish at the summit and usually longer than broad, the length of the leaf-blade being about three times the distance from the base of the sinuses to the summit of the petiole, the usually accepted characteristics of *H. acutiloba*. In various parts of the range where the two taxa meet, putative hybrids are encountered which cannot be placed in either *H. acutiloba* or *H. americana*. An example of this is represented by the collection of *Steyermark 73114* from Reynolds County, Missouri (steep, north-facing wooded slopes along West Fork of Black River, T 32 N, R 2 W, sec. 1, southeast of West Fork P. O., 7½ mi. northeast of Bunker, April 26, 1952, in herb. Chi. Nat. Hist. Mus.). At this locality the uppermost acid chert slopes are occupied by *H. americana*, while the lower and middle limestone slopes are inhabited by *H. acutiloba*. Similar intermediate hybrid specimens were found in Carter County, Missouri, where both taxa are present, and in Lake County, northern Illinois, where the problem of intermediate plants presented itself to the authors at the outset of this study.

Forms of acute-lobed *H. nobilis* of Europe often resemble specimens of *H. acutiloba*, and, similarly, forms of round-lobed *H. nobilis* of Europe often markedly resemble plants of *H. americana*. It is, therefore, a matter of difficulty to distinguish some of the European forms of *H. nobilis* from one or the other of the two American taxa.

Petioles and scapes. Length of the petioles in *H. americana* varies from 4-15 cm. long in flowering specimens. In both the round-lobed and acute-lobed forms of *H. nobilis* of Europe, the petioles vary from 3-17 cm. long in flowering material. In *H. acutiloba* the petioles are slightly longer, varying from 6-20 cm. long.

The scapes of European *H. nobilis* in flowering specimens average somewhat longer than those of the American plants, equaling or surpassing the length of the petioles. The petioles and scapes of the European *H. nobilis* are usually less pubescent than those of the American plants, and especially of *H. americana*.

Sepal length. With respect to the length of the sepals, the

longest extremes were encountered in the European plants, the round-lobed form of European *H. nobilis* varying from 7-17 mm. long, averaging 10.17 mm., while the acute-lobed form of European *H. nobilis* varied from 7-18 mm. long, averaging 10.85 mm. In the American plants, the sepals of *H. americana* varied from 6-14 mm. long, averaging 10.1 mm., those of *H. acutiloba* varied from 6.5-15 mm. long, averaging 11.6 mm. It will be noted that the measurements of the sepals of dried specimens of the American taxa are shorter in their extremes of length when compared with those of living plants, the sepal length in living specimens of *H. americana* varying from only 9-13 mm. long and in living specimens of *H. acutiloba* from only 10-15 mm. long.

Sepal width. In the matter of sepal width, the measurements are as follows: in *H. americana* 3-7.5 mm. wide, with an average of 4.68 mm.; in *H. acutiloba* 3-7.5 mm. wide, with an average of 4.85 mm., being nearly the same in both taxa. On the other hand, the round-lobed form of European *H. nobilis* varied from 3-10.5 mm. wide, averaging 5.5 mm., while the acute-lobed form of European *H. nobilis* varied from 3.5-9 mm. wide, averaging 5.15 mm. Therefore, both forms of European *H. nobilis* have an average sepal width greater than either of the American taxa. Again, it is to be noted that the smallest measurements of living plants of *H. americana* and *H. acutiloba* were always greater than those of dried specimens of the same taxa, and the average width of both taxa was always greater than that of dried material.

Length of involucre: With regard to the length of the involucre, plants of American taxa have longer bracts of the involucre than those of both forms of European *H. nobilis.* In *H. americana* the bracts of the involucre varied from 6-16 mm. long, averaging 8.66 mm., while those of *H. acutiloba* varied from 8-18 mm. long, averaging 10.5 mm. In living plants of the American taxa, the average length of the bracts of the involucre was 12.3 mm. in *H. americana* and 11.4 mm. in *H. acutiloba*, the measurements for living specimens again being greater than those of dried specimens for the average length encountered. Among European specimens of *H. nobilis*, it was found that the bracts of the involucre were shorter than those of the American taxa, varying from 5-11

mm. long in the round-lobed form of European *H. nobilis* with an average of 7.58 mm., while the acute-lobed form of European *H. nobilis* ranged in measurements from 5-14 mm. long, with an average of 7.95 mm., the acute-lobed form having, therefore, a somewhat greater length than the round-lobed form.

Width of involucre. The width of the bracts of the involucre in both American taxa is greater on the average and in the extreme than that for both the round- and acute-lobed forms of European *H. nobilis.* In *H. americana* the width varies from 3-10 mm. wide in dried material, with an average width of 5.35 mm., and in *H. acutiloba* the width varies from 3-10 mm., with an average width of 5.05 mm. However, among the European *H. nobilis* the width of the round-lobed form ranges from only 3-6 mm. wide, averaging 4.25 mm., while the acute-lobed form ranges from 2.5-7.5 mm. wide, averaging 4.63 mm., therefore, being similar to the round-lobed form of *H. nobilis.* Both as to length and width of the bracts of the involucre, the American taxa of *Hepatica* exceed those of the European *H. nobilis* as regards not only average, but also the extremes in length and width.

The differences found between the American and the European taxa of *Hepatica* are tabulated in the following table:

	Involucre length	Involucre width	Sepal length	Sepal width
H. americana (dried)	6-16 8.66 (aver.)	3-10 5.35 (aver.)	6-14 10.1 (aver.)	3-7.5 4.68 (aver.)
H. americana (living)	9-17 12.3 (aver.)	7.5-9 7.25 (aver.)	9-13 11.6 (aver.)	5.5-8 6.5 (aver.)
H. acutiloba (dried)	8-18 10.5 (aver.)	3-10 5.05 (aver.)	6.5-15 11.6 (aver.)	3.5-7.5 4.85 (aver.)
H. acutiloba (living)	7-18 11.4 (aver.)	4-9 5.95 (aver.)	10-15 11.75 (aver.)	4-8 6.75 (aver.)
H. nobilis (round-lobed of Europe)	5-11 7.58 (aver.)	3-6 4.25 (aver.)	7-17 10.17 (aver.)	3-10.5 5.5 (aver.)
H. nobilis (acute-lobed of Europe)	5-14 7.95 (aver.)	2.5-7.5 4.63 (aver.)	7-18 10.85 (aver.)	3.5-9 5.15 (aver.)

Achenes. Fernald (Rhodora **19:** 45. 1917) stated, "In *H. nobilis* of Europe the plump, conic-ovoid achene tapers to a short thick beak which is terminated by the sessile stigma.

In the American plant, on the other hand, the much more slender fusiform or lance-subulate achene is terminated by a very slender and definite, often curved, style." A study by the present author was made of those specimens of *Hepatica* in Europe and North America containing mature achenes in order to ascertain whether or not the differences mentioned by Fernald could be upheld. As relatively few achenes were available in the herbarium material examined, those of living plants were collected and studied.

Results of this study indicate that the American and European taxa cannot be distinguished by achenial differences as noted by Fernald. A specimen in the Gray Herbarium (mountainous woods near Innsbruck, Austria, May, 1839, herb. *J. Gay*) shows achenes with curved, slender styles. Another sheet in the Gray Herbarium (Alpes Mes Brianconnet, May 6, 1870, *M. Moggridge*) also shows a curved, slender style. The illustration of the achene and style in Hegi's Illus. Flora von Mittel-Europa (Band 3.3. *t.116, fig. 1b)* shows a type of slender style which can be matched in material from the United States. Some specimens from the United States may also exhibit ovoid achenes with relatively short styles in well-pressed and flattened specimens, and there appears to be no correlation between slender, lance-subulate achenes and slender, definite, often curved styles. The specimens cited above from the Gray Herbarium do not accord with Fernald's characterization of European material.

PRESENT INTERPRETATION

From a comparative study of *Hepatica* in Europe and North America, it is to be noted that much overlapping is encountered in measurements of involucre and sepals. Furthermore, there do not appear to be any achenial differences between the plants of Europe and North America. In general, it may be stated that the sepals of the American plants of *Hepatica* are narrower on the average than those of the European *H. nobilis*, that the involucre of the American plants are greater in both length and width on the average than in *H. nobilis*, that the petioles and scapes of the Euro-

pean plants are less pubescent than those of the American, and that the scapes of the European plants average somewhat longer than those of the American plants at anthesis.

The European *H. nobilis* exhibits similar variation with respect to differences in the apex of the leaf lobes as does the American material of the genus, perhaps less sharply so. The variation of the apex of leaf lobes in the American plants appears correlated also with similar variation in the apex of the bracts of the involucre. Aside from such differences, and in the corresponding leaf shape and proportion of leaf-lobing to the body of the leaf-blade, there is little else to use as distinguishing characters between the American taxa. Since the differences in relative length and width of involucre and sepals in *Hepatica* are measurable ones, it is believed that the American taxa can and should be kept distinct from the European, but as separate varieties, and not as separate species. It would seem more in keeping with a natural classification to treat the European and American taxa as conspecific under *H. nobilis*, the European plants being maintained as acute-lobed or round-lobed forms of *H. nobilis* var. *nobilis*, the American plants maintained as varieties of *H. nobilis*.

It is proposed, therefore, that the name of the European species, *Hepatica nobilis* Schreb., the oldest available valid specific epithet for the group under consideration, be used to include the later described American plants. As such, the American plants are here interpreted as American variations of a widely distributed species, *H. nobilis*. *Hepatica nobilis* var. *nobilis* becomes the name for the widely distributed European species, while *H. nobilis* var. *acuta* and *H. nobilis* var. *obtusa* become the names for the American plants formerly passing as *H. acutiloba* and *H. americana*.

Considered thus, *H. nobilis* with European and American varieties may be likened to similar cases of *Asplenium Ruta-muraria* L. var. *Ruta-muraria* and var. *cryptolepis* (Fern.) Wherry, *Polypodium vulgare* L. var. *vulgare* and var. *virginianum* (L.) Eaton, *Pteridium aquilinum* var. *aquilinum* and vars. *pubescens*, *latiusculum*, and *pseudocaudatum*, *Cypripedium Calceolus* L. var. *Calceolus* and var. *parviflorum*

(Salisb.) Fern. and var. *pubescens* (Willd.) Correll, *Linnaea borealis* L. var. *borealis* and var. *americana* (Forbes) Rehd.

The essential synonymy involved is as follows:

1a. **Hepatica nobilis** Schreb. var. **nobilis,** Spicil. Fl. Lips. 39. 1771 Based on *Anemone Hepatica* L. Sp. Pl. 538. 1753. *Hepatica triloba* Gilib. Fl. Lith. **2:** 273. 1781; Chaix in Vill. Hist. Pl. Dauph. **1:** 336 1786. *Anemone triloba* Stokes, Bot. Mag. Med. **3:** 243. 1812. *Anemone Hepatica* var. *acutiuscula* Pritzel in Linnaea **15:** 690. 1841. *Hepatica Hepatica* Karst. Fl. Deutschl. 559. 1883. *Hepatica triloba* var. *typica* Beck Fl. Nied.-Oesterr. 407. 1890. *Hepatica nobilis* var. *typica* Beck in Wiener Illustr. Gartenzeit. **21:** 344. 1896. *Anemone Hepatica* subsp. I. *typica* var. *α typica* Ulbrich in Engl. Bot. Jahrb. **37:** 270. 1906.

1b. **Hepatica nobilis** Schreb. var. **obtusa** (Pursh) Steyerm., comb. nov. Based on *Hepatica triloba* Gilib. *α obtusa* Pursh, Fl. Am. Sept. **2:** 391. 1814. *Hepatica triloba* Gilib. var. *americana* DC. Syst. Nat. **1:** 216. 1817. *Hepatica americana* (DC.) Ker in Edwards Bot. Reg. 5. *t. 387.* 1819. *Hepatica nobilis* f. *obtusa* (Pursh) Beck von Mannagetta, Wien. Illustr. Gartenzeit. **21:** 349. 1896. *Hepatica nobilis* var. *obtusa* consists of the following five forms: **Hepatica nobilis** Schreb. var. **obtusa** (Pursh) Steyerm. f. **obtusa. Hepatica nobilis** Schreb. var. **obtusa** f. **candida** (Fern.) Steyerm., comb. nov. Based on *Hepatica americana* (DC.) Ker f. *candida* Fern. Rhodora **19:** 46. 1917. **Hepatica nobilis** var. **obtusa** f. **purpurea** (Farw.) Steyerm., comb. nov. *Hepatica americana* f. *purpurea* Farw. Pap. Mich. Acad. **3:** 97. 1924. Based on *Hepatica Hepatica* var. *purpurea* Farwell, Rep. Mich. Acad. **17:** 169. 1916. **Hepatica nobilis** var. **obtusa** f. **rhodantha** (Fern.) Steyerm., comb. nov. Based on *Hepatica americana* f. *rhodantha* Fern. Rhodora **19:** 46. 1917. **Hepatica nobilis** var. **obtusa** f. **Cahnae** (Farw.) Steyerm., comb. nov. Based on *Hepatica americana* f. *Cahnae* Farw. Pap. Mich. Acad. **3:** 97. 1924.

1c. **Hepatica nobilis** var. *β* **acuta** (Pursh) Steyerm., comb. nov. Based on *Hepatica triloba* Gilib. *β acuta* Pursh, Fl. Am. Sept. **2:** 391. 1814. *Hepatica acutiloba* DC. Prodr. **1:** 22. 1824. *Hepatica triloba* var. *acutiloba* (DC.) Warne, in Am. Ent. & Bot. **2:** 313. 1870. *Anemone acutiloba* (DC.) Laws. Rev. Canad. Ranunc. 30. 1870. *Hepatica acuta* (Pursh) Britton, Ann. N. Y. Acad. **6:** 234. 1891. *Hepatica nobilis* f. *acutiloba* (DC.) Beck von Mannagetta, Wien. Illustr. Gartenzeit. **21:** 349. 1896. *Hepatica nobilis* var. *acuta* consists of the following forms: **Hepatica nobilis** var. **acuta** (Pursh) Steyerm., f. **acuta. Hepatica nobilis** var. **acuta** f. **albiflora** (R. Hoffm.) Steyerm., comb. nov. Based on *Hepatica acutiloba* DC. f. *albiflora* R. Hoffm. Proc. Boston Soc. Nat. Hist. **36:** 268. 1922. **Hepatica nobilis** var. **acuta** f. **rosea** (R. Hoffm.) Steyerm., comb. nov. Based on *Hepatica acutiloba* DC. f. *rosea* R. Hoffm. Proc. Boston Soc. Nat. Hist. **36:** 268. 1922. **Hepatica nobilis** var. **acuta** f. **plena** (Fern.) Steyerm., comb. nov. Based on *Hepatica acutiloba* DC. f. *plena* Fern. Rhodora **49:** 216. 1947.

THE BLESSED THISTLE IN VIRGINIA

A. B. Massey

The blessed thistle, *(Cnicus benedictus*, L.) was introduced into the United States, probably Virginia, in the colonial days. Fernald (Rhodora 46:158) questioned its persistence in the State. He found it in a clover field near Petersburg one season but found none in the same place the following year. Of course, if it is not a persistent species, it should not be listed in the state flora.

We have specimens in the V. P. I. Herbarium collected during the growing season, April to July, in Buckingham, Westmoreland, Albemarle, Shenandoah, Nansemond, Henrico, Goochland, Accomac, Mecklenburg and Amherst Counties. Collections were made on the same farm in Amherst County in 1944 and 1947. Fernald records it in Dinwiddie County near Petersburg. Rosette stages, collected in dormant condition from Accomac (December) and Franklin (October) Counties are in the Herbarium. Allen Kates, Weed Specialist, V. P. I., Agricultural Extension Service, reports it in Halifax, Nottaway, Richmond and Northampton Counties. The oldest record of the species in Virginia is that in Gronovius' Flora Virginica (1762) page 117. ("Carduus benedictus caulibus, infirmis supinis, flore flavo, Clayt. n. 926") Clayton's collection was probably from the peninsula between the James and York Rivers, in eastern Virginia, known as The Middle Neck.

Clayton's early record indicates that the blessed thistle was introduced into Virginia by the early colonists. The plant contains a very bitter principle, *Cnicin*, and was considered to be an important medicinal plant. It possesses the property of "simple bitters" thought to stimulate the liver and kidneys. In the early days it was not only thought to possess medicinal properties but also prevented evil, whence the specific name — benedictus — blessed thistle.

It is evident that the species has been persistent in Virginia for many years. Fernald's collection in Dinwiddie County was in a clover field. The field was probably mowed for hay before the thistle bloomed. Being a biennial (some would call it a winter annual) its appearance the next season

was prevented by the destruction of the plants before seed formation.

Despite Fernald's apprehension to the contrary, the species is very definitely naturalized in Virginia and is to be included in the flora as are many other European species. — VIRGINIA POLYTECHNIC INSTITUTE.

SESBANIA EXALTATA (RAF.) CORY IN ESSEX COUNTY, MASSACHUSETTS. — While collecting on the city dump in Lynn, Massachusetts last fall I found a single plant of what I took to be a seedling of some woody legume. However the long even-pinnate leaves did not fit any species that I could think of. Finally through the kind assistance of Dr. Carroll E. Wood of the Arnold Arboretum it was run down to *Sesbania exaltata* (Raf.) Cory, a tall annual native to our southern states and adventive northward. This seems to be the first collection of the plant in Massachusetts. The chances of its becoming established this far North appear to be very poor since the plant showed no suggestion of flowers or buds in early October when a killing frost may occur almost any night. City dump off Broad Street, Lynn, Essex County, Massachusetts, *Stuart K. Harris 18832* (3 October 1958). Specimen in the herbarium of the New England Botanical Club. — STUART K. HARRIS, BOSTON UNIVERSITY.

Volume 62, No. 739, including pages 175-204, was issued July 21, 1960.

REFERENCE LIBRARY

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

REED CLARK ROLLINS, Editor-in-Chief

ALBERT FREDERICK HILL
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Vol. 62 September, 1960 No. 741

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

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Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Avenue, Cambridge 38, Mass.

Subscriptions and orders for back issues (making all remittances payable to RHODORA) should be sent to Albert F. Hill, Botanical Museum, Oxford Street, Cambridge 38, Mass.

Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

RHODORA

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

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NOVELTIES IN THE DOMINICAN FLORA

JOSÉ DE JS. JIMÉNEZ[1]

Since the publication of Moscoso's *Catalogus Florae Domingensis* in 1943, several botanical explorations in our country have been carried out which have resulted in the discovery of a number of unrecorded species, some new to science, others first records for our Island whose centers of dispersion are localized in the surrounding countries and islands.

The continuing correspondence with foreign botanical libraries, herbaria and botanists, the acquisition of ancient and modern scientific works on the West Indian Floras and the revision of many taxonomic groups by eminent botanical authorities have brought forth a better knowledge of our vegetation, the identification of new species, the reduction of many binomials to synonymy, new combinations according to recent concepts in the consideration of genera and species and so forth.

Out of these botanical investigations and from the study of our collections, we have found about 700 species not included in the above mentioned work. With them we have prepared a Supplement to it hoping that in the near future we will be able to have it in print. At the request of many friends, we have extracted the novelties from the manuscript of the supplement and they are presented here in anticipation of their ultimate inclusion in the larger work.

[1]Taxonomist of the Instituto Botánico "RAFAEL M. MOSCOSO," UNIVERSITY OF SANTO DOMINGO, Dominican Republic.

I am particularly indebted to Dr. Reed C. Rollins and Dr. Richard A. Howard for the kindness of reading the manuscript and making very useful and valuable suggestions. To both gentlemen my warmest gratitude.

PALMACEAE

Zombia antillarum Bailey var. **GONZALEZII** Jiménez, var. nov.

Haec varietas a forma typica speciei fructibus minoribus sordide flavis et pyriformibus recedit.

This variety differ from the type species in having smaller fruits, 15-16 mm. long, 10-11 mm. broad; in their pyriform shape instead of globose-oblong and in the dirty-yellow colour instead of waxy-white. DOMINICAN REPUBLIC: Near Santiago Rodriguez, Province of Santiago Rodriguez, *Jiménez 2590-B*, (type).

ORCHIDACEAE

Bletia purpurea (Lam.) DC var. **ALBA** Ariza-Julia & Jiménez, var. nov.

Haec varietas a forma typica speciei floribus albis et disco flavo recedit.

This variety differ from the type species in having white flowers and a yellow disc. DOMINICAN REPUBLIC: Collected by Mr. Luis Ariza Julia at Yásica, on the road, between Yásica and Yasiquita bridges, Province of Puerto Plata and cultivated in his garden, *Jiménez 3714*, (type).

Laeliopsis domingensis Lindl. var. **ALBA** Ariza-Julia & Jiménez, var. nov.

Haec varietas a forma typica speciei floribus albis differt.

This variety differ from the typical species in having white flowers. DOMINICAN REPUBLIC: El Canal, Sosúa, Province of Puerto Plata, *Jiménez 3715*, (type).

CAESALPINIACEAE

Cassia enneryana (Britton) Jiménez, comb. nov.

Chamaecrista enneryana Britton, N. A. Flora 23. 5: 275. 1930.

Cassia fitchiana (Britton & Rose) Jiménez, comb. nov.

Peiranisia fitchiana Britton & Rose, N. A. Flora 23. 4: 264. 1930.

Cassia froidensis Jiménez, nom. nov.

Chamaecrista haitiensis Britton, N. A. Flora 23. 5: 276. 1930.

Cassia haitiensis (Britton) Jiménez, comb. nov.

Peiranisia haitiensis Britton, N. A. Flora 23. 4: 261. 1930.

Cassia leonardae (Britton) Jiménez, comb. nov.

Chamaecrista leonardae Britton, N. A. Flora 23. 5: 281. 1930.

RUTACEAE

Zanthoxylum anadenium (Urb. & Ekm.) Jiménez, comb. nov.

Fagara anadenia Urb. & Ekm. in Ark. foer Bot. Bd. 24A. 4: 15. 1931.

Zanthoxylum azuense (Urb. & Ekm.) Jiménez, comb. nov.

Fagara azuensis (Urb. & Ekm.) in Ark. foer Bot. Bd. 22A. 8: 55. 1928.

Zanthoxylum domingense (Krub & Urb.) Jiménez, comb. nov.

Fagara domingensis Krug & Urb. in Engl. Jahrb. 21: 586. 1896.

Zanthoxylum furcyense (Urb.) Jiménez, comb. nov.

Fagara furcyensis Urb. in Ark. foer Bot. Bd. 20A. 5: 16. 1921.

Zanthoxylum haitiense (Urb.) Jiménez, comb. nov.

Fagara haitiensis Urb. in Ark. foer Bot. Bd. 20A. 15: 36. 1926.

Zanthoxylum lenticellosum (Urb. & Ekm.) Jiménez, comb. nov.
Fagara lenticellosa Urb. & Ekm. in Ark. foer Bot. Bd. 24A. 4: 13. 1931.

Zanthoxylum leonardi (Urb.) Jiménez, comb. nov.
Fagara leonardi Urb. in Fedde Repert. 24: 5. 1927.

Zanthoxylum nigrescens (Urb. & Ekm.) Jiménez, comb. nov.
Fagara nigrescens Urb. & Ekm. in Ark. foer Bot. Bd. 22A. 8: 53. 1928.

Zanthoxylum obcordatum (Urb. & Ekm.) Jiménez, comb. nov.
Fagara obcordata Urb. & Ekm. in Ark. foer Bot. Bd. 20A. 15: 36. 1926.

Zanthoxylum obtriangulare (Urb.) Jiménez, comb. nov.
Fagara obtriangularis Urb. in Ark. foer Bot. Bd. 22A. 8: 54. 1928.

Zanthoxyllum tetraphyllum (Urb. & Ekm.) Jiménez, comb. nov.
Fagara tetraphylla Urb. & Ekm. in Ark foer Bot. Bd. 20A. 5: 15-16. 1926.

ERICACEAE

Lyonia apiculata (Sleumer) Jiménez, comb. nov.
Xolisma apiculata Sleumer in Fedde Rep. 36: 270. 1934.

Lyonia cryptogonia (Sleumer) Jiménez, comb. nov.
Xolisma cryptogonia Sleumer in Fedde Rep. 36: 270. 1934.

Lyonia elongata (Sleumer) Jiménez, comb. nov.
Xolisma elongata Sleumer in Fedde Rep. 36: 271. 1934.

Lyonia longelaminata (Sleumer) Jiménez, comb. nov.
Xolisma longelaminata Sleumer in Fedde Rep. 36: 271. 1934.

Lyonia orbiculata (Sleumer) Jiménez, comb. nov.
Xolisma orbiculata Sleumer in Fedde Rep. 36: 272. 1934.

Lyonia pseudotinensis (Sleumer) Jiménez, comb. nov.
Xolisma pseudotinensis Sleumer in Fedde Rep. 36: 272. 1934.

Lyonia urbaniana (Sleumer) Jiménez, comb. nov.
Xolisma urbaniana Sleumer in Fedde Rep. 36: 273. 1934.

ASCLEPIADACEAE

Cynanchum aemulans (Schlecht.) Jiménez, comb. nov.
Metastelma aemulans Schlecht. in Urb. Symb. Ant. 1: 252. 1899.

Cynanchum crassiusculum (Schlecht.) Jiménez, comb. nov.
Metastelma crassiusculum Schlecht. in Urb. Symb. Ant. 1: 261. 1899.

Cynanchum domingense (Schlecht.) Jiménez, comb. nov.
Metastelma domingense Schlecht. in Urb. Symb. Ant. 1: 251. 1899.

Cynanchum glabrius (Markgraf) Jiménez, comb. nov.
Metastelma glabrius Markgraf in Ark. foer Bot. Bd. 22A. 10: 103. 1928.

Cynanchum gonavense Jiménez, nom. nov.
Metastelma ekmanii Markgraf in Ark. foer Bot. Bd. 22A. 10: 104. 1928.

The binomial *C. ekmanii* cannot be applied to this species because Alain in *Flora de Cuba 4: 205. 1957* had given it to the Cuban endemic species *Astephanus Schlechterianus Urb.*

Cynanchum gracile (Dcne.) Jiménez, comb. nov.
Metastelma gracile Dcne. in DC. Prodr. 8: 515. 1844.

Cynanchum haitiense Jiménez, nom. nov.
Metastelma astephanoides Schlecht. in Urb. Symb. Ant. 8: 551. 1920.
Cynanchum astephanoides has been used by Standley for the mexican species, *Vincetoxicum astephanoides Gray.* See Standley's Trees and Shrubs of Mexico, Contr. U. S. Nat. Herb. 23: 1177. 1924.

Cynanchum leptocladum (Dcne.) Jiménez, comb. nov.
Metastelma leptocladum (Dcne.) Schlecht. in Urb. Symb. Ant. 1: 261. 1899.

Cynanchum leptophyllum (Schlecht.) Jiménez, comb. nov.
Astephanus leptophyllus Schlecht. in Urb. Symb. Ant. 1: 241. 1899.

Cynanchum occidentale (Spreng.) Jiménez, comb. nov.
Tainionema occidentale (Spreng.) Schlecht. in Urb. Symb. Ant. 1: 264. 1899.

Cynanchum picardae (Schlecht.) Jiménez, comb. nov.
Metastelma Picardae Schlecht. in Urb. Symb. Ant. 1: 252. 1899.

Cynanchum stenoglossum (Schlecht.) Jiménez, comb. nov.
Metastelma stenoglossum Schlecht. in Urb. Symb. Ant. 1: 252. 1899.

Cynanchum tylophoroides (Schlecht.) Jiménez, comb. nov.
Metastelma tylophoroides Schlecht. in Urb. Symb. Ant. 1: 259. 1899.

Matelea constanzana Jiménez, nom. nov.
Poicillopsis Tuerckheimii Schlecht. in Urb. Symb. Ant. 7: 339. 1912.
The binomial *Matelea Tuerckheimii* cannot be utilized in this case because Woodson has previously used it, based on the central american *Gonolobus Tuerckheimii* Donn. See his work "The North American Asclepiadaceae" in Ann. Mo. Bot. Gard. 28: 234. 1941.

Matelea crispiflora (Urb.) Jiménez, comb. nov.
Poicillopsis crispiflora Urb. in Fedde Repert. 19: 7. 1923.

LENTIBULARIACEAE

Pinguicula casabitoana Jiménez, sp. nov.

Herba epiphytica, acaulis; folia integra, lineari-spatulata, basi rosulata, piloso-glandulosa, succulenta, glauca, 1.5-2 cm. longa; scapus axillaris, piloso-glandulosus, uniflorus, usque 5 cm. longus; corolla alba, 7 mm. longa.

Stemless and epiphytic herb, growing on dry twigs of different plants in wet places; leaves forming a basal rosette, linear-spatulate, entire, succulent, glaucous, glandular-hairy, 1.5-2 cm. long, 1 mm. wide; scapes solitary, 1 — flowered, axillary, very slender, glandular-hairy, erect, the longest 5 cm. long; calyx 5 — merous, densely glandular-hairy; corolla white, 5 — merous, 7 mm. long; spur short, obtuse; capsule not seen.

Similar to the Cuban *P. lignicola Barnh.* but differing from it in its more dense pubescence, longer leaves, longer scapes and shorter corollas. DOMINICAN REPUBLIC: Alto de Casabito, Province of La Vega, 1400 m. above sea level, *Jiménez 3029*, (type). Loma La Vieja, Province of La Vega, *Ekman, H-14051.*

NEW PLANT RECORDS FROM ILLINOIS

ROBERT H. MOHLENBROCK AND JOHN W. VOIGT

Continued botanical exploration by the authors with efforts centered on southern Illinois has resulted in several additions to the state flora. Since 1955, there have been 114 species and varieties discovered for the first time in the State, and of these, 70 have been taken by the authors, their colleagues, or students in the southern Illinois area. This report concerns the new records discovered in the field or herbarium during 1958 and 1959.

All specimens listed are to be found in the herbarium of Southern Illinois University, Carbondale, with the exception of *Carex oxylepis* var. *pubescens* which has been deposited with Dr. F. J. Hermann, Crops Research Division, U. S. D. A., Beltsville, Maryland, and *Medicago orbicularis* which is in the University of Illinois herbarium.

Ophioglossum vulgatum L. var. **pycnostichum** Fern. JACKSON CO.: sandstone ledge, exposed rock, beneath *Juniperus virginiana*, Giant City State Park, June 25, 1955, *R. H. Mohlenbrock 7976A*.

This variety, distinguished from var. *pseudopodum* by its dark green, shining sterile blade, has been recorded previously from the states bordering the southern counties of Illinois. Our specimens were determined by Dr. R. M. Tryon of the Gray Herbarium.

Carex austrina (Small) Mackenzie. JACKSON CO.: one mile north of DeSoto, along Illinois Central Railroad, May 27, 1958, *D. Schuchardt*. PERRY CO.: Pyatts Crossroads, along railroad, May 27, 1958, *R. H. Mohlenbrock 10009*.

This western sedge has been found previously eastward to southeastern Missouri. The two Illinois stations extend the range by nearly fifty miles. At both places, the sedge was growing abundantly with numerous other sedges and grasses which are typical of these prairie railroad sidings.

Carex emmonsii Dew. UNION CO.: dry wooded slope, growing beneath *Pinus echinata*, Pine Hills, 3 miles northeast of Aldridge, T11S, R3W, sect. 10, April 25, 1959, *R. H. Mohlenbrock* and *R. R. MacMahon 10142*.

Here is another member of the *Carex artitecta* complex, flowering very early in the year. The plant is densely cespitose. Most of the spikes are aggregated into a head about 1.5 cm. long. This is the first authentic specimen in Illinois of this species, although it was reported in early literature as occurring in Illinois.

Carex physorhyncha Liebmann. RANDOLPH CO.: ledge of bluff, 1½ miles west of West Point, April 24, 1958, *R. H. Mohlenbrock 9910*. UNION CO.: cherty slope, Pine Hills, 3 miles northeast of Aldridge, T11S, R3W, sect. 10, April 27, 1958, *R. H. Mohlenbrock 9927*.

Although this species has the general appearance of the very common *Carex artitecta*, it is readily distinguished by its cord-like stolons. It was rather abundant in the cherty slopes beneath stands of *Pinus echinata* in the Pine Hills, a habitat reminiscent of the Missouri Ozarks where it occurs also.

Carex oxylepis Torr. & Hook. var. **pubescens** Underw. HARDIN CO.: wooded east-facing slope, Blind Hollow, T11S, R9E, sect. 20, *R. H. Mohlenbrock 8632.*

According to Dr. F. J. Hermann (personal correspondence) who determined the specimen, this unusual *Carex* is known now from its original collection in Tennessee, from Stone County, Arkansas *(R. A. Reed GI-32)*, and from the Illinois station.

Carex striatula Michx. UNION CO.: rich mesophytic woods, Panther's Den, near Wayside, 1959, *R. R. MacMahon 157.*

In Illinois, this species most nearly resembles *Carex blanda*, but differs in its pedunculate staminate spike and narrower leaves. It was known previously westward as far as southern Indiana.

Urtica dioica L. var. **dioica.** MONROE CO.: along gravel road, near Fults, May 22, 1958, *R. H. Mohlenbrock 9986.*

All previous collections of *Urtica dioica* in Illinois are referable to var. *gracilis* or var. *procera*. Therefore, the findings of typical *U. dioica* along a country lane in Monroe County came as somewhat of a surprise. The typical variety bears many more stinging hairs, particularly on the surface of the leaves.

Polygonum setaceum Baldw. var. **interjectum** Fern. JACKSON CO.: roadside ditch bordering swampy pin-oak woods, on east side of Illinois Route 3, T9S, R3W, section 29, one mile east of Gorham, September 15, 1958, *R. H. Mohlenbrock 10013.*

A colony of this more eastern variety covered an area of nearly 25 square feet in a ditch in which water stands for most of each year. Known previously only as far west as central Kentucky, this variety differs from var. *setaceum* by having the lower leaf surfaces glabrous.

Draba cuneifolia Nutt. var. **foliosa** nov. var. A typo differt caulibus foliis. RANDOLPH CO.: edge of limestone bluff, one mile northwest of Prairie du Rocher, T5S, R9E, section 16, *R. H. Mohlenbrock 5969.*

This variety is strange in that it has leaves the entire length of the stem. As a result, it cannot be keyed out to *Draba cuneifolia* in any of the current manuals. It grows atop limestone bluffs in association with *Draba cuneifolia* var. *cuneifolia* and *Draba reptans.*

Rubus orarius Blanchard. JACKSON CO.: along Illinois Central Railroad, Carbondale, *J. R. Swayne 62.*

Following the conservative treatment of this genus by Gleason (1952), the binomial *R. orarius* should be applied to the specimen cited above. Botanists wishing to attempt to further delimit this specimen would likely come to *Rubus alumnus.*

Crataegus collina Chapm. JACKSON CO.: border of low pin-oak woods,

T9S, R3W, section 29, 1-1/4 miles northeast of Gorham, September 22, 1958, *R. H. Mohlenbrock & J. W. Voigt 10072*.

This unusual hawthorn is rather common throughout the extensive swampy pin-oak woods of western Jackson County. It seldom grows in thickets but is usually found scattered throughout the woodlands. The small trees sometimes reach a height of 20 feet. The nearest known station to the Illinois locality is in the southeastern counties of Missouri.

Medicago orbicularis L. JACKSON CO.: strip mine, June 29, 1950, *Alten Grandt* (no other data available).

The specimen of this rare waif, unlisted by Fernald (1950), is deposited in the herbarium of the University of Illinois.

Phlox bifida Beck var. **cedaria** (Brand) Fern. JACKSON CO.: sandstone cliff near Etherton, "Saltpeter Cave", May 12, 1955, *R. H. Mohlenbrock s. n.*

This nearly glabrous variety is rather rare throughout its entire range. Fernald (1950) lists it from "s. Ind. to Tenn. and Ark."

Myosotis sylvatica Hoffm. JACKSON CO.: campus of Southern Illinois University, Carbondale, *Biggs s. n.*

The Garden Forget-me-not was collected as an adventive in fresh dirt on the campus of Southern Illinois University.

Gerardia fasciculata Ell. JACKSON CO.: in sandy field along highway 12, two miles west of Carbondale, August 12, 1958, *R. H. Mohlenbrock 10037*.

The discovery of this Coastal Plain species in southern Illinois came as a very pleasant surprise. Numerous plants of this species occurred in a sandy field with an equally numerous amount of *Gerardia tenuifolia*. *Gerardia fasciculata* has been collected in the neighboring state of Missouri.

Solidago strigosa Small. UNION CO.: cherty slope beneath *Pinus echinata*, 3 miles northeast of Aldridge, T11S, R3W, section 10, September 22, 1958, *R. H. Mohlenbrock s. n.*

This interesting Ozark goldenrod was previously known from Missouri and Arkansas south to Georgia and Louisiana. It is distinguished by its conspicuous basal rosettes with villous-nerved leaves. Filiform stolons are produced late in the season. — DEPARTMENT OF BOTANY, SOUTHERN ILLINOIS UNIVERSITY, CARBONDALE.

LITERATURE CITED

FERNALD, M. L. 1950. Gray's Manual of Botany. American Book Company.

GLEASON, H. A. 1952. The new Britton and Brown Illustrated Flora of the northeastern United States and adjacent Canada. New York Botanical Garden, New York.

ARABIS PERSTELLATA IN TENNESSEE

REED C. ROLLINS

The continued interest of Dr. E. Lucy Braun in *Arabis perstellata* during the years following her original description of it in 1940 resulted in an excellent account of the growth habit and of other significant characteristics of the species (1956). However, even with Dr. Braun's original descriptive data (1940), the supplemental information she has provided, and with the type and topotype specimens before me for study, it has been difficult to decide whether new collections of an *Arabis* from Tennessee should or should not be referred unequivocally to *A. perstellata.* The plants in question were first seen and collected in April, 1959, by Dr. R. B. Channell of Vanderbilt University, along a calcareous bluff of Stones River in Davidson County, Tennessee. Since then, Dr. Channell has made three ample collections, (one of these with Dr. Kenneth A. Wilson) with the plants in various stages of development, and he has guided me to the locality so that I could make first hand observations.

The Tennessee plants, from their morphology, belong to *Arabis perstellata* without doubt, but they differ in certain particulars from Kentucky populations which formed the basis for the original description of the species. As pointed out by Braun, *A. perstellata* is related to the species previously known as *A. dentata* (Torr.) T. & G. the name used by Hopkins in his monograph of *Arabis* in eastern North America (1937). The name *Arabis dentata,* which originated with Torrey in the genus *Sisymbrium,* is untenable in *Arabis* because it is a later homonym. Fernald (1946) renamed *A. dentata* as var. *Shortii* of *A. perstellata,* and more recently Gleason (1952) raised var. *Shortii* to specific rank, an action approved by Braun (1956) since it restored the original relationship she thought obtained with respect to the two entities involved.

In the present brief study, the first question I have sought to resolve to my own satisfaction is whether the very local *Arabis perstellata* and the widely distributed *A. Shortii* are, in fact, distinct species as maintained by Gleason and by Braun or whether a single species with several varieties, as

proposed by Fernald, best represents the facts. The evidence I have adduced coincides with that expressed by Braun (1956) and I am convinced that *A. perstellata* and *A. Shortii* should be regarded as separate species.

Up to the present, *Arabis perstellata* has been known from a relatively restricted area in northern Kentucky along the calcareous bluffs of Elkorn Creek in Franklin County. This area is approximately two hundred miles northeast of the Stones River, just east of Nashville, where Dr. Channell discovered an extensive population of *A. perstellata* that I think is somewhat different from the Kentucky population and is deserving of nomenclatural recognition.

Arabis perstellata E. L. Braun, var. **ampla** Rollins, var. nov.

Herba perennis, caulibus 4-8 dm. longis, foliis radicalibus viridibus amplis 8-15 cm. longis, n=7[1].

Type in the Gray Herbarium collected in rich woods along calcareous bluffs of Stones River, about 1 mile northwest of junction of Couchville Pike and Fuqua Road, off Fuqua Road and about 3 miles northeast of Una, Davidson County, Tennessee, May 28, 1960, *R. B. Channell 7998*; isotype at Vanderbilt University. Other collections from the same general locality: April 7, 1959, *R. B. Channell 7707* (GH; VDB); April 20, 1959, *Kenneth A. Wilson and R. B. Channell 709* (GH; VDB); April 25, 1960, *Reed C. Rollins, R. B. Channell, Otto T. Solbrig, Frank J. Hilferty and David G. Lloyd 6012* (GH; VDB); May 20, 1960, *R. B. Channell 7966* (GH; VDB).

The most striking features of var. *ampla* are the large leaves terminating the main axis and the greatly elongated fertile branches. In fact, the dimensions of leaves and branches in var. *ampla* are two to three times those of var. *perstellata*. In addition, the leaf-margins are more nearly entire being shallowly repand to dentate and uncommonly toothed in var. *ampla*, whereas they are usually dentate, toothed or lobed in var. *perstellata*, the lower cauline leaves and some of the leaves of the vegetative axis being lyrate-pinnatifid. In var. *perstellata*, the dense covering of trichomes produces a whitish to greyish-green appearance, whereas in

[1]Chromosome count made by Dr. Otto T. Solbrig.

var. *ampla*, the trichomes are much less dense and the plants are green or only slightly greyish.

The growth habit of var. *ampla*, appears to be very much like that of var. *perstellata*. The main axis is terminated by a tuft of petiolate leaves and the fertile branches arise laterally below this terminal group of active leaves in the axils of leaves of the previous growing season. The leaves of the lateral fertile branches are strongly auriculate except toward the base of the branch. In both varieties, the early season leaves are more toothed or lobed than are those developed later in the season. Var. *ampla* is more lax and weak-stemmed than var. *perstellata* and the leaves seem to have a thinner texture than do those of var. *perstellata*. As to the nature and distribution of the trichomes, the varieties are similar except for the relative abundance per unit of surface area, the density being much greater in var. *perstellata*.

From all of the evidence we have at the present time, each variety of *Arabis perstellata* is very restricted in distribution. The new variety *ampla* of Tennessee represents a significant range extension for the species and it appears that the Kentucky and Tennessee populations have been separated long enough to have evolved distinctive features worth nomenclatural recognition. — GRAY HERBARIUM OF HARVARD UNIVERSITY.

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ALEXANDER WILLIAM EVANS (1868-1959)

JOHN R. REEDER AND CHARLOTTE G. REEDER

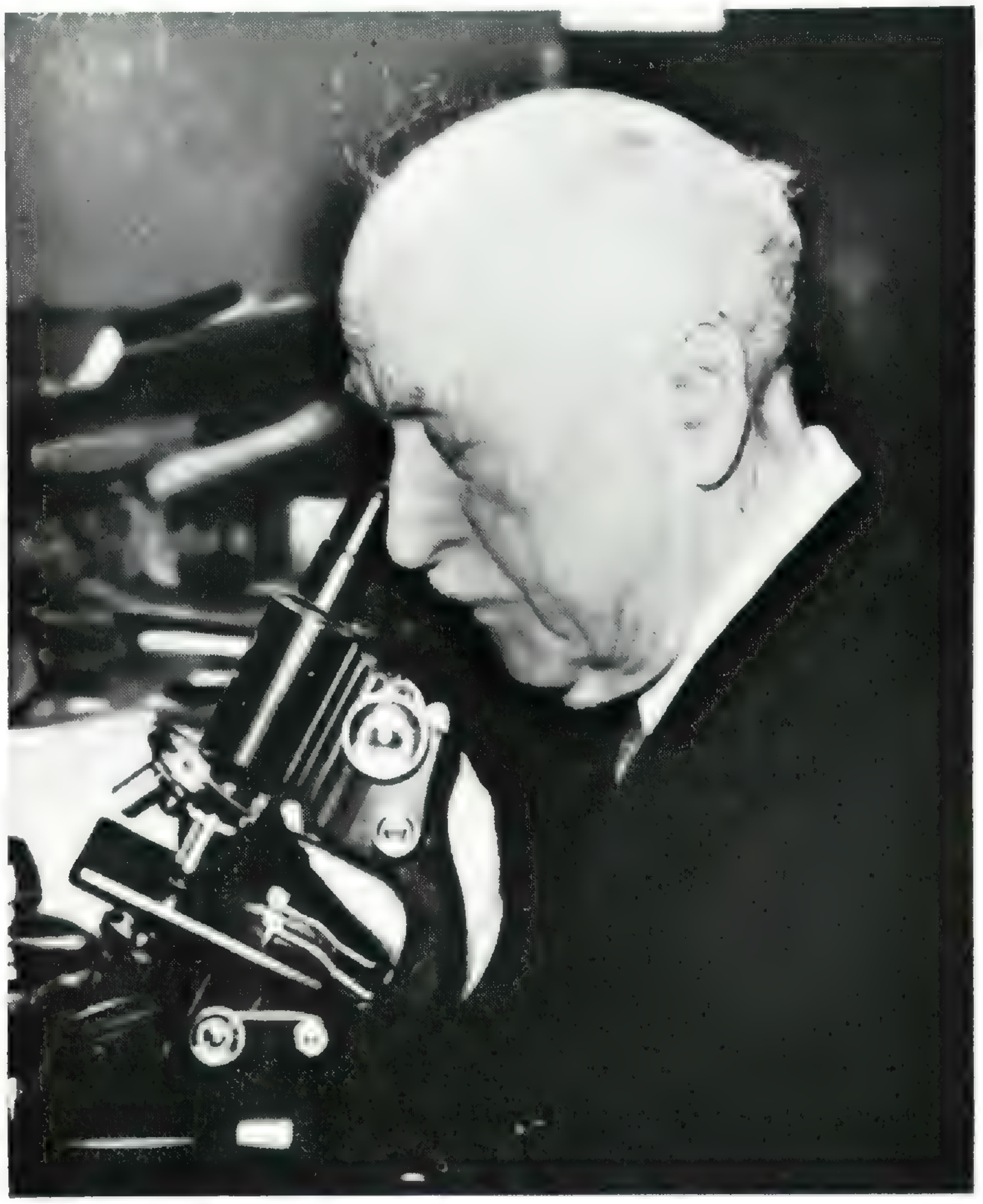
Dr. Alexander W. Evans, one of the world's leading authorities on hepaticology and lichenology, died December 6, 1959 at the age of 91. Death came as the result of pneumonia contracted as he was recovering from an operation for a broken hip suffered on October 18th. Until this accident he had been in good health and customarily spent part of each day working in his room at the Osborn Botanical Laboratory.

The son of a manufacturer and shipping line operator, Alexander William Evans, the youngest of seven children, was born in Buffalo, New York, on May 17, 1868. The Evans family was one of the oldest and most respected in Buffalo, having been engaged in the shipping business there since 1832. Here Evans spent his early boyhood, but in 1880, after his father's death, the family moved to New Haven and this was Dr. Evans' home for the remainder of his life. That Evans inherited his longevity is suggested by the fact that his mother had attained the age of 99 years at the time of her death in 1925.

Upon graduation from Hillhouse High School in New Haven, Evans enrolled in the Sheffield Scientific School of Yale University, receiving a Ph.B. degree in 1890. As an undergraduate he was a distinguished student, and the Class Book for 1890 cites him for "excellence in all studies." Apparently he had an exceptional aptitude for the sciences and languages. At one time or another he stood at the top of his class in German, mathematics, chemistry, and physics, or shared this honor with a fellow student. He was elected secretary-treasurer of his senior class. Although preparing for medical school, Evans was collecting and studying liverworts throughout his college years, and the subject of his senior essay was "Classification of the Hepaticae."

Entering the Yale Medical School in 1890, Evans received his M.D. degree two years later. In his final year there he also served as an assistant in chemistry. It seems that his heart was really in botany, however, for although making a fine record in medical school, he had published three papers on the Hepaticae by the time he had received his medical

degree. As soon as his two-year internship in the New Haven Hospital was completed, he left for Europe in order to study botany under Professor Kny at the University of Berlin. These studies were soon interrupted, for the following



ALEXANDER W. EVANS (1868-1959)
Photograph by I. M. Lamb

spring he received news of the unexpected death of his former professor, Daniel Cady Eaton, along with an invitation to return to Yale and take charge of botanical instruction. Appointed first as instructor (1895-1901), then as assistant professor (1901-1906), Dr. Evans was promoted in 1906 to Daniel Cady Eaton Professor, a position he held until his retirement in 1936. As an emeritus professor he continued his researches with as much vigor as before and these were

not interrupted until the accident which shortly preceded his death.

It is characteristic of Dr. Evans that even though he already held a doctor's degree (M.D. 1892), soon after his appointment as botanist he began preparing a treatise to present as a Ph.D. dissertation. The story is told that, as the only member of the botany department, he rejected his first thesis, and, although publishing it, admonished himself to prepare a more satisfactory one. This advice was apparently followed, for he received the Ph.D. degree in 1899. Although somewhat farcical, this story does illustrate well the high standards which Dr. Evans always set for himself with respect to his research.

Dr. Evans was an indefatigable investigator and he was the author of some 165 research papers[1] during his lifetime, many of which included beautiful illustrations from his own pen. His researches on Hepaticae, interrupted during his internship in the New Haven Hospital, were again resumed with vigor after he joined the Yale faculty. For 60 years (1896-1956) one or more research papers appeared annually except for the periods 1928-29, 1941-42, and 1946. The first of these lapses can be explained when we note that a 147 page treatise on lichens appeared in 1930, along with two shorter articles on the Hepaticae. During the second lapse it seems that Dr. Evans was working intensively to become familiar with the microchemical methods described by Asahina of Japan and to satisfy himself as to their value in lichen taxonomy. In 1943 he published two papers in which he discussed these techniques as applied to the systematics of the Cladoniae. The lapse in 1946 should need no explanation since at that time Evans was already in his 78th year of life.

For many years Dr. Evans confined his studies to the Hepaticae and by 1940 had published more than 130 papers dealing with this group. These works include the descriptions of eight new genera and some 130 new species, as well as innumerable transfers. Rather early, however, an interest in lichens was developing, and he published a short note

[1]A full bibliography of Dr. Evans' writings is to be published in The Bryologist.

on this group in 1916. Ten years later, his first long paper on lichens appeared, and at about this time he took up the serious study of the genus *Cladonia*. From 1940 onward, his researches were confined to this genus, and in fact he was working on a manuscript the day before he broke his hip. It is remarkable that although nearly 70 when he learned of Asahina's work, Dr. Evans almost immediately began to apply these microchemical methods, and continued to use them for the remainder of his life. He was quite intrigued with the techniques, and delighted in showing anyone interested the beautiful crystals, pointing out their diagnostic value.

For a number of years after joining the Yale faculty, Dr. Evans spent part of each summer in Europe. These trips were only in part botanical. He was deeply interested in art and journeyed to observe these treasures in France, Italy, Austria, Germany, and other areas. He also visited botanical laboratories and accumulated literature he needed for his studies. A certain amount of botanical collecting was also accomplished, as there are in the Yale Herbarium specimens of Bryophytes collected by Evans in a number of European countries. In connection with these trips, he attended the second (Paris, 1900), third (Vienna, 1905), and fourth (Brussels, 1910) International Botanical Congresses. At the Vienna meeting he was appointed a member of the committee concerned with the nomenclature of Hepaticae and was reappointed at successive Congresses until the ninth (Montreal, 1959). In 1953 he was invited to accept the Honorary Presidency of the Section on Lichenology at the VIII International Botanical Congress to be held in Paris the following year. He was greatly pleased by this honor and hoped to attend the Congress, but unfortunately was unable to make the trip.

In connection with his botanical studies, Dr. Evans collected extensively in his home state of Connecticut. This was begun while he was still an undergraduate student, and in the Yale Herbarium are specimens of liverworts collected by him in 1888. He did field work in other parts of New England as well, and there are records of numerous trips which he made to the White Mountains in New Hampshire.

He also visited adjacent Canada, as well as New Jersey and New York. Additional collecting was done by him in some of the southern states, particularly the Carolinas, Alabama, and Florida. Five trips to this latter state were made especially to collect *Cladonia* and most of the counties of the state were visited. The first trip was in 1938, the others annually from 1947 to 1950. The Caribbean Islands also received his attention and two trips were made to Puerto Rico (1900, 1902) and to Jamaica (1903, 1906). Some of the other islands were visited on subsequent trips made some 20 years later. Another excursion took him to Columbia, Venezuela, and Panama.

In 1914 Evans married Phoebe Whiting, the daughter of a prominent New Haven family. Three daughters were born of this marriage. Mrs. Evans and two of the daughters survive him. Many of the trips which Dr. Evans made after 1914 were in the company of some member of his family.

The collecting activities of Dr. Evans were not confined exclusively to plant specimens; he was also an avid stamp collector. This hobby was apparently a source of great pleasure to him, and he devoted considerable time to it, particularly in his later years. At the time of his death he had amassed a substantial collection which was valued at several thousand dollars.

A gentle kindly person and rather retiring, Dr. Evans had a warm personality, a keen sense of humor, and enjoyed the respect and esteem of all who knew him. His former students remember him as an excellent teacher. To have published as extensively as he did, he was of necessity much preoccupied with research. Nevertheless, he was generous with his counsel which was freely given when requested, but it was not in his nature to intrude his views upon others unsolicited. His gift for writing concise English was well-known, and elicited comments from even the late M. L. Fernald, himself no literary pariah[2]. For more than

[2]In this connection, Fernald in 1949 had inadvertently referred to "the late Alexander W. Evans". Being fast on his feet to make an unexcelled recovery, Fernald, just a few months before his own death, wrote [Rhodora 52: 49-51. 1950] a delightful little article entitled, "Long Life to Alexander W. Evans" in which he not only paid tribute to Evans but forcefully brought out the point that many botanists live to a ripe old age. ED.

a quarter of a century (1907-1934) Evans was a member of the editorial board of the Bulletin of the Torrey Botanical Club, serving as its editor-in-chief from 1914-1924. He was also an associate editor of The Bryologist for a number of years.

That he was not a narrow specialist is shown by the fact that he was a charter member of the Connecticut Botanical Society, as well as its first president. He was also a long-time member of the Torrey Botanical Club and the New England Botanical Club. For many years a member of the Connecticut Academy of Arts and Sciences, he served as its secretary from 1897-1903. He was Vice President of the Botanical Society of America in 1911, while in 1912 he was elected to membership in the American Academy of Arts and Sciences.

Esteem for Dr. Evans and respect for his researches continued long after his official retirement. He took great pride in the fact that on the occasion of the centennial of its Sheffield Scientific School, in 1947, his alma mater, Yale University, awarded him an honorary Sc.D. degree. Another honor, which touched him as deeply came to him in his 88th year. As part of its 50th anniversary celebration, the Botanical Society of America included him as one of the 50 most outstanding living American botanists. — OSBORN BOTANICAL LABORATORY, YALE UNIVERSITY.

OBSERVATIONS ON THE EPIDERMAL STRUCTURE AND STOMATAL APPARATUS OF SOME MEMBERS OF THE ARACEAE

EDGAR E. WEBBER[1]

Engler (4) determined that if the *Araceae* were to be classified as a natural group, flower structure alone was insufficient. Detailed anatomical and morphological study led him to classify the family into eight subfamilies, the Pothoideae, Monsteroideae, Calloideae, Philodendroideae, Lasioideae, Colocasioideae, Aroideae, and Pistioideae.

An earlier taxonomic work by Engler was published by DeCandolle (3) and was basically similar to his aforementioned system, except that in his earlier study Engler had *Calla* placed with the Pothoideae, *Nephthytis* and *Syngonium* included in the Lasioideae, and *Dieffenbachia* and *Aglaonema* were separated out into the Aglaonemoideae. The later study caused Engler (4) to include *Calla* in the Calloideae, a new subfamily; *Syngonium* was removed to the Colocasioideae, and *Dieffenbachia* and *Aglaonema* were placed in separate tribes in the Philodendroideae.

Following this more complete system, then, representatives of all but two subfamilies, the Calloideae and Pistioideae, were studied. Members of these two groups were unavailable for my work.

MATERIALS AND METHODS

Mature leaves were taken from plants grown under similar environmental conditions in a greenhouse and cut into sections approximately 4 mm. square. These were immediately fixed in formalin-propionic-acid, then embedded in paraffin, sectioned, and stained with safranin and fast green. Cross sections were made at 10μ, and paradermal sections at 12 to 14μ. No distinction was made in the cross sections as to whether they were parallel with or at right angles to the main axis of the leaf.

DISCUSSION AND RESULTS

A. EPIDERMIS. — Dalitzsch (2) noted that the epidermal

[1]I wish to thank Dr. F. M. Hueber for making the drawings (Fig. 1-8) from my photomicrographs.

cells found in various genera of the *Araceae* were of different sizes and shapes. Also, that in *Amorphophallus bulbifer*, *Homalomena coerulescens*, and *Alocasia cuprea* undulations of the side walls occurred, as seen in surface view. He made no distinction as to which epidermis was concerned. Of the genera sampled in this study the following situations were observed. In *Nephthytis Cravenreuthii* both epidermal layers have cells with most pronounced side wall undulations (Fig. 1). *Aglaonema costatum*, *A. pictum*, and *A. marantaefolium* show undulated walls only in upper epidermal cells. *Crytosperma Johnstonii* shows the undulations, not as pronounced, present in both epidermal layers. The lower epidermis of *Arisarum vulgare* and the upper epidermis of both *Arum italicum* and *Arum hygrophyllum* exhibit very weakly undulated cell walls. Watson (7) proposes an explanation of waviness of epidermal cell walls on the method of hardening of the differentiating cuticle. Working with *Hedera helix* L., he determined that most undulations appeared in leaves grown in light shade.

In cross sectional aspect the epidermal cells may be raised in their centers giving the entire cell a more or less dome shaped appearance. Such was observed in *Porphyrospatha Hoffmannii*, *Philodendron gloriosum*, *Philodendron andreanum*, and *Scindapsus pictus argyreus*. *Anthurium crystallinum* and *Spathiphyllum floribundum* are also of this nature. Dalitzsch (2) reported a button-like papilla in *Colocasia antiquorum* which may be an extreme development of the phenomenon reported here (Fig. 2). In addition the aforementioned *Porphyrospatha* has the outer walls of the lower epidermal cells rounded. Some genera show more raising of the epidermal cells than others.

The cuticle of several species exhibited various degrees of "ribbing" which may occur on either epidermis or on both. In surface view the "ribs" may be in the form of roughly parallel striations (Fig. 3), or may be arranged in a complex pattern (Fig. 4). Plants with cuticles of the former type include *Prophyrospatha Hoffmannii*, *Pothos hermaphroditus*, *Pothos jambea*, *Aglaonema costatum*, *Aglaonema pictum*, *Aglaonema marantaefolium*, *Homalomena pygmea*, and *Spathiphyllum cannaefolium*.

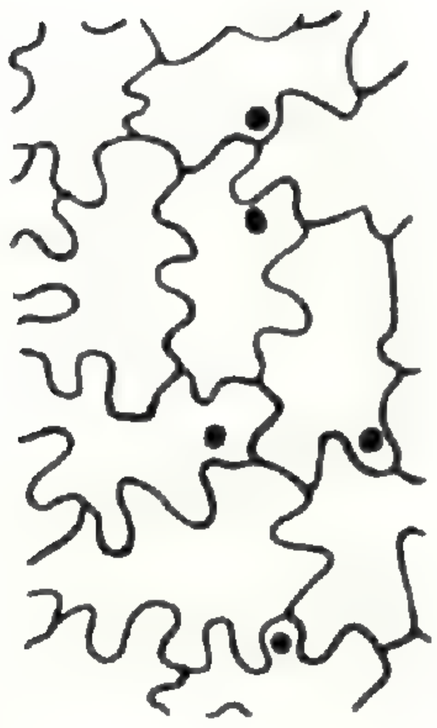


FIG. 1

FIG. 2
(After Dalitzsch)

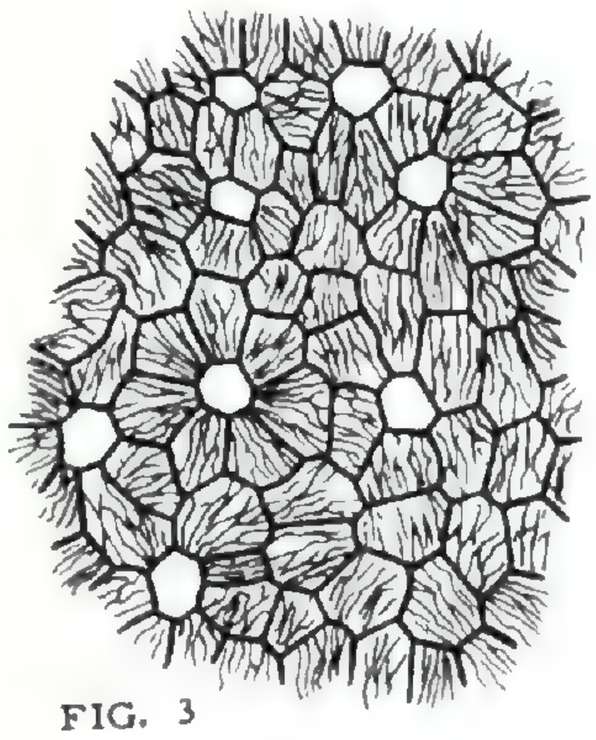


FIG. 3

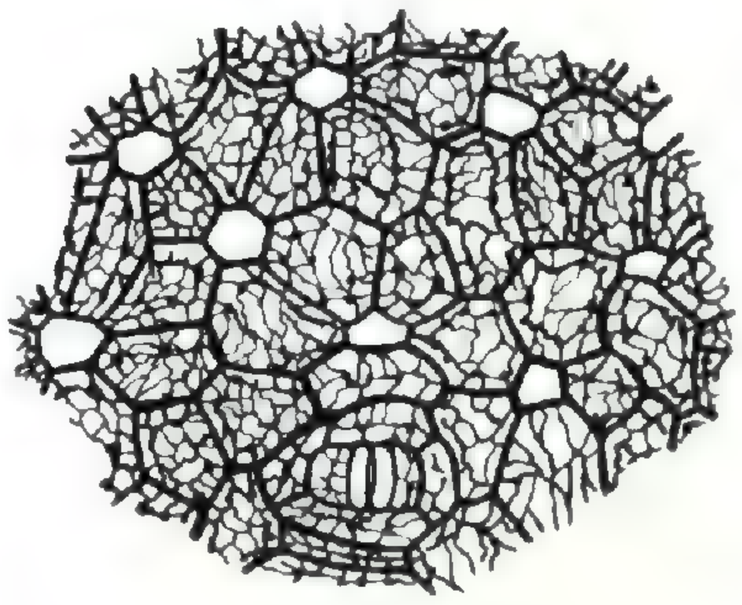


FIG. 4

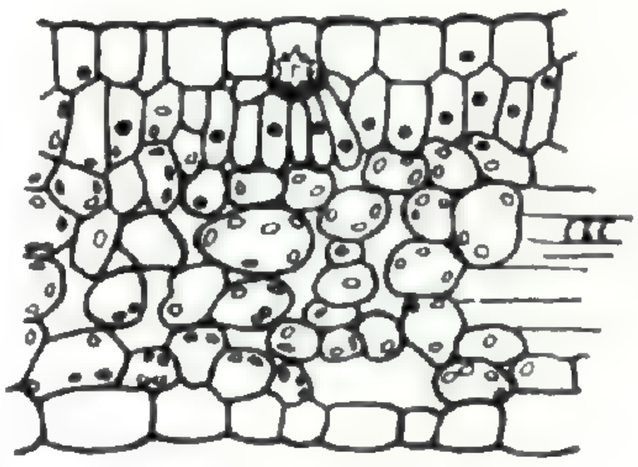


FIG. 5a

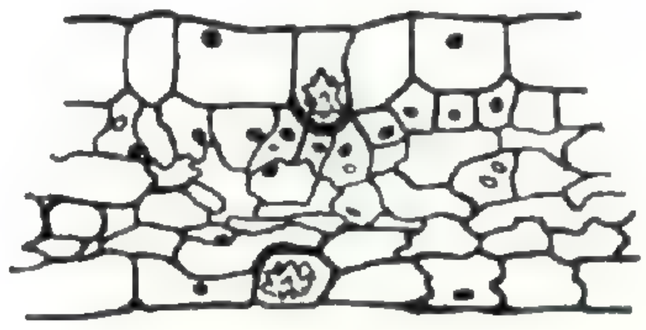


FIG. 5b

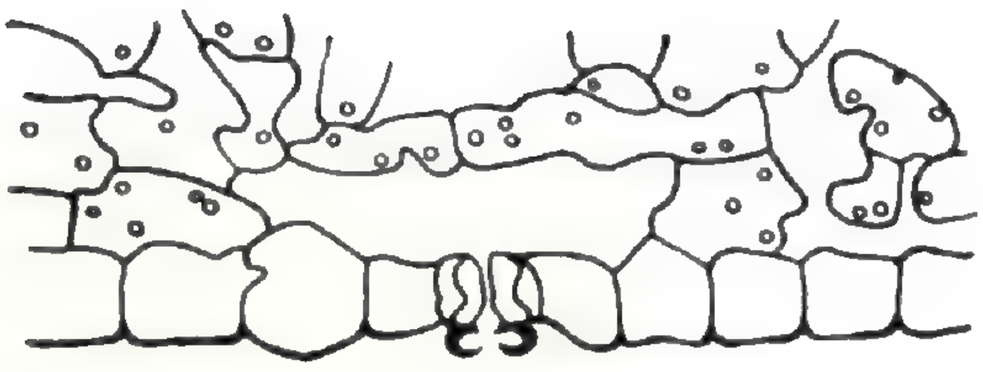


FIG. 6

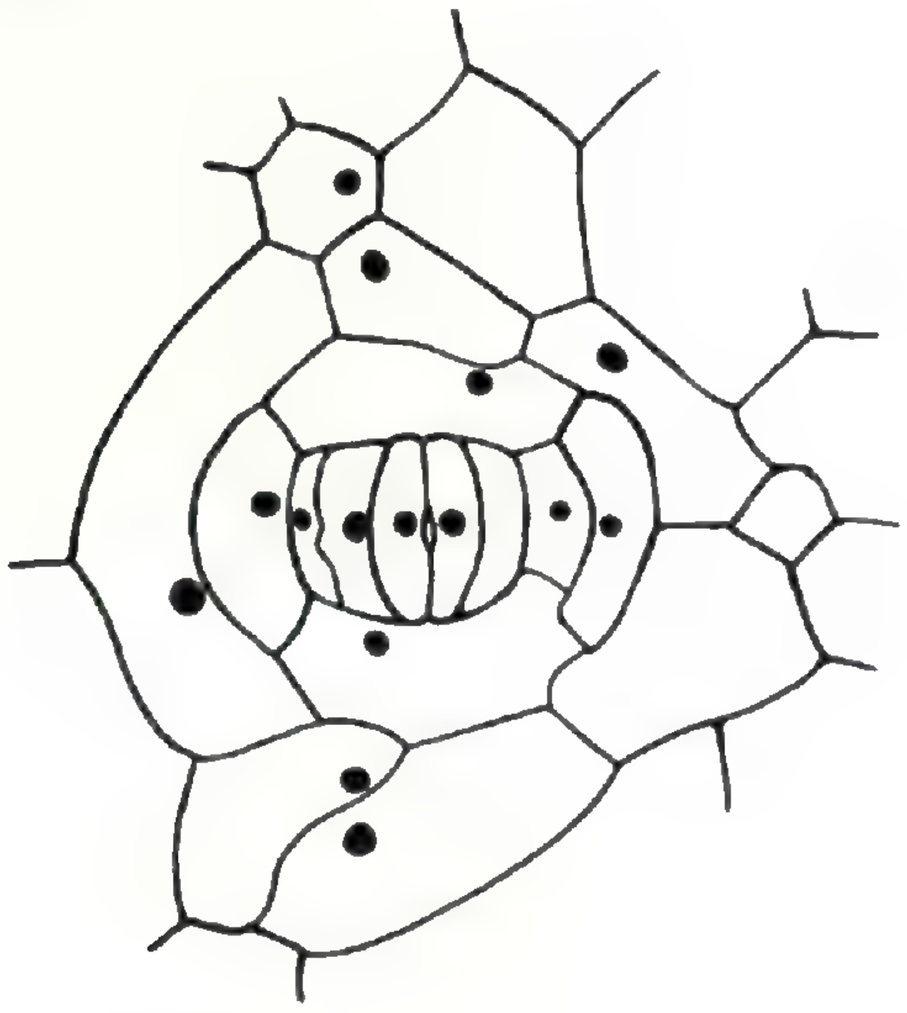


FIG. 8

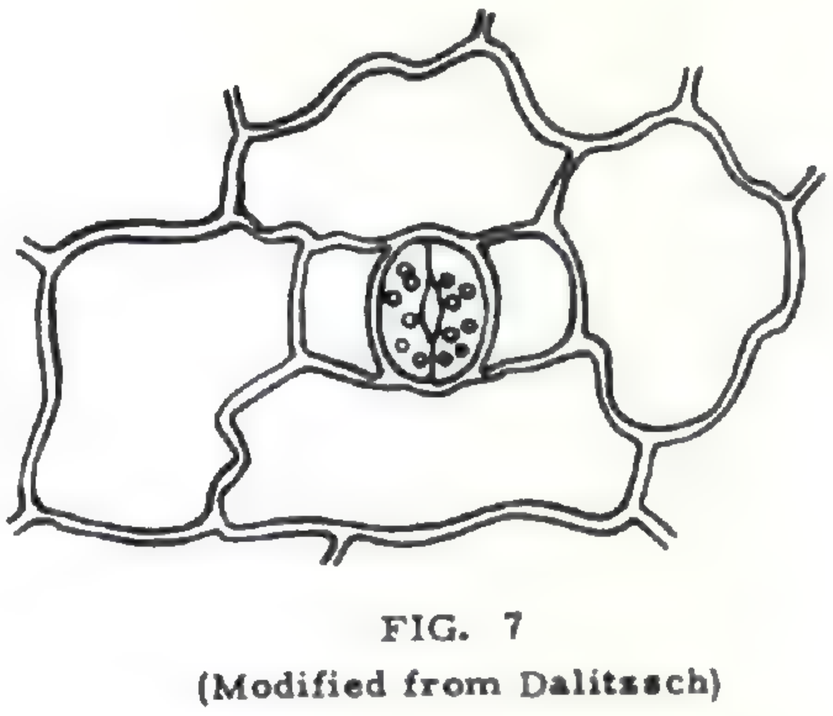


FIG. 7
(Modified from Dalitzsch)

An interesting feature was noted in the epidermis of the two species of *Pothos*. In surface view the epidermal cells radiate like spokes in a wheel from a central, somewhat circular cell. Under oil it was observed that this central cell appeared to have depth due to wall thickenings which became evident upon focusing at different levels. An examination of cross sections showed these thickenings to be due to the cell walls of certain palisade cells which orient themselves beneath the epidermal cell (Fig. 5a). In *Pothos jambea* a crystal is invariably present in such an epidermal cell (Fig. 5b). With polarized light it was noted that the radiating arms of these crystals, as seen most clearly in *Pothos hermaphroditus*, assume the form of an arrowhead.

Dalitzsch (2) mentioned that in the lower epidermal cells of *Anthurium Scherzerianum* and *A. magnificum* the occurrence of calcium oxylate granules, and these he called "druzen". Of the species considered here only *Anthurium scandens* was found to contain such cells. These "druzen" can be observed macroscopically as small, dark dots in the under surface of the leaf. Microscopic sections failed to give clear and definite evidence for the presence of such cells, and accordingly free-hand sections of several leaves were made. Here it was noted quite clearly that the "druzen" was not a cell but an aggregation of cells, differing in appearance from the epidermal cells, circularly arranged about what appeared to be a central pore. The exact nature of this pore was not determined, nor did it seem in any way like a stoma. Furthermore, each cell in this ring, and the number of rings of cells varied from one to three, was completely filled with a dark brown substance. Dalitzsch (2) had also applied the term "druzen" to an extracellular substance which collected under the epidermis.

Many genera in the *Araceae* have perforations of varying sizes in their leaves. In *Monstera deliciosa*, for example, the exact cause of these holes is unknown. By examination of the leaves of *Epipremnum pinnatum* the sequence in their formation was clearly seen. First, a small, non-chlorophyllous dot appeared. This enlarged slightly, followed by the presence of a tiny hole in the center of this white dot.

Through an increase in size this hole soon appeared as the typical perforation. The latter varied in size not only from leaf to leaf but also in the same leaf.

B. STOMATA. — In cross section, the accessory cells were seen to partially surround the guard cells, and the wall of the latter which was farthest from the stomatal pore was slightly concavely bent. This was true in all plants studied. The stomata neither extended above nor below the epidermal surface. Wall thickenings of the guard cells gave the appearance of "horns" in all species. The length of these horns was not constant, but varied with the specimen from very short protuberances to rather long and reflexed ones. *Schismatoglottis* and *Arisarum* are examples of the former, while the latter was seen in *Aglaonema marantaefolium* (Fig. 6).

With respect to the type of stomatal apparatus, Dalitzsch (2) distinguished two types "from which one species or another deviates only in a small degree". In surface view one kind of apparatus is seen to consist of one pair of accessory cells at the sides of the guard cells (Fig. 7). The second general type has two pairs of accessory cells at the sides and one additional pair which limit the top and bottom of the stoma, giving the appearance of a ring of four cells about the stomate, thus showing a total of six accessory cells (Fig. 4). In *Pothos jambea* this ring often has an additional accessory cell at the side, giving a total of seven or eight (Fig. 8). The upper epidermis of *Philodendron bipanifolia* has two pairs of accessory cells at the sides of the guard cells, and only occasionally is there a full ring present. The upper epidermis of *Monstera deliciosa* also exhibited a diversion from the one ring type; here, the first pair of accessory cells often appeared as two individual cells occupying the space where normally one accessory cell would be. This two-celled condition may be either on one or on both sides of the guard cells. Another variation noted by Dalitzsch (2) in *Dieffenbachia Seguine* was the occurrence of a double or triple ring of accessory cells. In *Dieffenbachia Hoffmanii* great variation in the type of stomatal apparatus was manifested, and in a few cases such a double ring was seen. *Monstera deli-*

TABLE I. Plants listed according to type and distribution of stomatal apparatus[1].

I.

a) *One pair of accessory cells*
Nephthytis Cravenreuthii
Philodendron gloriosum
Philodendron Florida compacta
Philodendron andreanum
Anthurium undatum
Anthurium scandens
Anthurium crystallinum
Aglaonema pictum

b) *One ring of four accessory cells*
Scindapsus aureus
Philodendron lacineatum
Spathiphyllum floribundum
Pothos jambea

II.

Syngonium erythrophyllum
Prophyrospatha Hoffmannii
Monstera acuminata
Monstera sp.
Dieffenbachia Hoffmannii
Philodendron auriculatum
Spathiphyllum cannaefolium

III.

a) *One pair of accessory cells*
Epipremnum sp.
Spathicarpa sagittifolia
Arisarum vulgare
Arum italicum
Arum hygrophyllum

III.

b) *One ring of four accessory cells*
Monstera Friedrichsthalii
Schismatoglottis nova-guineensis

IV.

a) *Upper epidermis one pair of accessory cells; lower, one ring of four*
Philodendron oxycardium
Rhodospatha picta

b) *Upper epidermis with two lateral pairs of accessory cells; lower, one ring of four*
Philodendron bipanifolia

c) *Upper epidermis poorly preserved; lower with one ring of four*
Scindapsus pictus argyreus
Epipremnopsis Huegueliana

V.

Philodendron cordatum varigatum
Syngonium podophyllum
Pothos hermaphroditus
Crytosperma Johnstonii
Aglaonema costatum
Homalomena pygmea
Epipremnum pinnatum
Monstera deliciosa

VI.

Raphidophora celatocaulis

[1]I - Stoma on lower epidermis only; same apparatus.
II - Stoma on lower epidermis only; apparatus variable.
III - Stoma both surfaces; apparatus same for a given layer or for both layers.
IV - Stoma both surfaces; apparatus different.
V - Stoma both surfaces; apparatus similarly variable.
VI - Stoma both surfaces; lower epidermis constant, upper variable.

ciosa, in addition to the above phenomenon, often appeared to approach the double ring condition, but it was difficult to determine whether this might in part be due to flattened epidermal cells rather than distinct accessory cells. *Syngonium podophyllum* and *Pothos hermaphroditus* also appeared to approach the double ring condition.

Contrary to earlier work (2), the *Araceae* can not be separated into two groups each based on a distinct type of stomatal apparatus, for the following situations are evident: an epidermis may be entirely of one type of apparatus; an epidermis may vary in the type of apparatus; two epidermal layers may be of one type, or they both may have a similar variation in the type of apparatus; one epidermis may vary in one type while the other is constant for a different type; or, both epidermal layers may be of the same type of apparatus.

Table I summarizes the species studied as to their stomatal apparatus.

CONCLUSIONS

It is customary to consider variability to be a primitive characteristic and constancy to be advanced. The Pothoideae would then be expected to show, perhaps, the most variation in stomatal apparatus, if the latter were to be used as a taxonomic feature. Bailey and Nast (1) found that stomatal features were of value in the anatomy and taxonomy of the *Winteraceae*. Rea (6) has also shown that the number of stomates in *Campanula* increases with light and dry habitat. Florin found the stomatal apparatus to be of very great significance in the taxonomy of the Cycads and Cycadeoides.

While anatomical details of the *Araceae* have here been further expanded and elaborated, it is doubtful if any taxonomic significance can be drawn from these findings.

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STEPPE, TAIGA, AND TUNDRA.[1] — Anyone here-abouts contemplating "the magnificent Flora USSR" may have wondered: "But what if some regional botanist within its range should desire to publish a flora of his area? Would that be allowed, and would divergent views in systematic botany be permitted, let alone supported, by national science organizations in the USSR?" That the answer is "yes" is signified by the appearance and contents of this two volume Flora of Central Siberia, by M. G. Popov. In addition to this, floras of the Murmansk, Tadzhik, Caucasus, Yakut, and Northern Mongolia regions have appeared during the 1950's.

The territory covered by this flora, as defined by the author, is 2000 kilometers east to west, and 1000 kilometers north to south. Westward its limit is 92° east longitude in the Enisee area, and eastward it extends to 122° east l., or the Olekmoi line; northward to the 60th parallel, and southward to about the 48th parallel, or the border of the Mongolian Peoples' Republic. A glance at a map of Canada will show that Alberta, Saskatchewan, and Manitoba, with southeastern British Columbia east of 120°, form a block almost exactly the same size, occupying almost the same territory latitudinally and longitudinally in the western hemisphere. In both territories the drainage is northeastern and northwestern, and within them eastern and western floristic elements of their respective continents meet.

The author, Popov, defines therein 6 principal areas: 1. The Eniseian; 2. The Saian Mountain Taigan area, mountains with a rich alpine flora, and a pine — larch taiga; 3. The Central Siberian Taigan area, mostly high plateau, with

[1]The Flora of Central Siberia by Mikhail Grigorevich Popov. Vol. I, 1957. pp. 1-556. Pls. 1-65. Vol. II, 1959. pp. 557-920. Pls. 66-104. Published by the East Siberian Affiliate of the USSR Academy of Sciences, Moskow — Leningrad. Foreword by Boris K. Shishkin, editor. Price approximately $4.00 per volume in US currency.

considerable steppe vegetation; 4. The Baikal Taigan area, the lake shore and the mountains bordering it, which have an extensive alpine tundra flora above a pine taiga; 5. The Daurian Steppe area, mostly plains, bordered northward by pine — larch taiga and southward by the Mongolian steppes; and 6. The Vitim — Patomsk Taigan area, with mountain ranges having an alpine flora above a Daurian larch taiga.

The political capital of this area is Irkutsk; and Baikal, the largest freshwater lake in Asia, and sixth largest in the world whose geological history extends back to Jurassic times, and whose hundreds of unique animal species are famous in zoology, is the center of geographical interest.

The author dedicates the flora to "the great botanist and man, Nikolai Stepanovich Turczaninov" or Turchaninov by modern transliteration, who was the leading botanist of past -century czarist Russia. The help of eleven individuals, ranging from the president of the Siberian Affiliate of the National Academy to two student assistants is acknowledged. No families or other groups were relegated to specialists; Popov is the sole author. There is a frontispiece portrait of Turczaninov, and a picture of the author at his work desk. Of the approximately 2000 numbered species in the flora, 143 are of "Turcz." authorship, while one genus and 11 species are named after him. The names Pallas, Bunge, and Willdenow appear frequently. However Linnaeus is the author of 682 of the species according to my count, and of about 300 genera in addition. *Sibiricus (a-um)* is the name of 50 taxa, while 20 species are *baicalenses*, and *daurica* or *dahurica* is the designation of 36.

Certain past-century travelers in Siberia had occasion to note in Irkutsk ("the Paris of Siberia") a spirit of political and religious independence from Moskow and Petersburg. Some such individuality is evident in the present volumes. In the introduction to what he designates "our conspectus" or "our conspectus flora" the author Popov writes: "Fundamentally only one system exists for Angiosperms, that outlined in 1818-1820 by Pyramus DeCandolle," . . . . . "I categorically reject the concept of (phylogenetic) family relationships in vogue among other botanists." However, out

of respect to "the custom established for us by Russians and Germans brought up on the Engler system" he places the Monocotyledons before the Dicotyledons. "I wish in no way to convey the idea that Monocotyledons preceded the Dicotyledons in evolution; both are of simultaneous origin." he writes.

The author's stand in regard to species is conservative, with only a moderate number of varieties being recognized. With genera he is more liberal. Thus, *Ranunculus salsuginosus* is *Halerpestes salsuginosa*, and *Potentilla fruticosa* is *Dasiophora fruticosa*, for example.

Except for certain cases noted below there are no keys to higher groups, families, genera, or species. In genera of several to many species there are key characters interlined between species or groups of species, in the style of the older Grays Manuals. The bulk of the 900 plus pages is occupied therefore by brief to prolonged descriptions of families, genera, species and ranges. The details of regional distribution are numerous and satisfyingly thorough. With the paragraph on the range of an acceptable, i. e. numbered species, one will find a descriptive line and locality or two for what the author considers inconsequential, or doubtful micro-species. Thus, *Carex*, inevitably the largest genus, has 94 numbered species, with 58 additional receiving more or less honorable mention. Similarly, while an approximate 2000 is the total number of species per the author's statement and the reviewer's check as well, the total treated or touched upon in some way is 2620 according to the index count.

"When genera or species are merged, or when a taxon is raised or lowered in rank, or reduced to synonymy," that, so someone wrote me in effect, "should be done only as part and parcel of a thorough study of the group concerned, not in a local list. Reasons should be given and specimens should be cited. The mere indication that the change seems desirable to the author is not enough." This stand has been echoed by others but it has rarely been followed. In the present work it is refreshing to note that there is little if any burial in synonymy without explanation. There are even a number

of resurrections. In the genus *Carex* for example, contrary to the Flora USSR Vol. III, many sectional and subsectional names by Kükenthal, Theodor Holm, Tuckerman, Drejer, et al. are restored, replacing those used by Krechetovich. Moreover "*Carex rigida* Goodenow", and "*Carex Goodenoughii* Gay", long since banished elsewhere (cf. Fernald, Rhodora 44: 229, 300. 1942), are back in good company.

Some evidence of editorial liberality is evident in that: (1) there is no definition or discussion of the Eniseian area; (2) there are numerous remarks and comparisons with related species outside the scope of the flora; (3) the table in the introduction lists 42 as the number of genera of Cruciferae, whereas only 39 are treated in the text; (4) notwithstanding "We provide no dichotomous keys for identification but separate genera into sections groups and series", yet keys, mostly extracted from the Flora USSR, for *Alchemilla, Hedysarum, Myricaria, Thymus,* and *Mentha,* and Shishkin's key to the genera of Umbelliferae from the same work are included.

The author notes that in his region endemics are comparatively few. However, two monotypic genera, *Borodinia baicalensis,* a crucifer, and *Tridactylina Kirilovii,* a composite, and 17 additional species are peculiar to the basin of Baikal. In comparison to the great number of animal endemics which have been and are still being described from the waters of the lake, these, obviously are not impressive.

All the geobotanical points of interest may not come within the scope of a review. However, similarities in this flora to that of montane and alpine New England, Canada, and the Rocky Mountains are inescapable. Nearly all of its species of ferns, *Juncus,* and *Potamogeton* are in the above areas. Of the principal formation, the mighty, vast and dense Taiga, the coniferous species are Eurasian, with the exception of the panboreal *Juniperus communis.* And of no little interest is the evidence that the ericaceous species in the shade of the Taiga: *Chimaphila umbellata, Moneses uniflora, Pyrola incarnata, P. minor, P. chlorantha, Ramischia secunda, R. obtusata, Monotropa hypopitys, Ledum palustre, Loiseleuria procumbens, Phyllodoce coerulea, Cassiope tetra-*

gona, C. ericoides, Andromeda polifolia, Cassandra calyculata, Arctostaphylos uva-ursi, Arctous alpina, Vaccinium uliginosum, V. myrtillus, V. vitis-idaea, Oxycoccus quadripetalus (O. palustris, O. oxycoccus syns.), are individually more pantaigan and panboreal than the coniferous species of the Taiga itself.

The quality of the paper, the printing, the binding, and especially the illustrations are well above that of the volumes of the Flora USSR, and compares very favorably with that of most modern floras.

The numerous instances of typification of boreal plants falling within its territory, and its abundance of distributional details should render this flora a necessity wherever plant systematics and plant geography are seriously studied. Of considerable contemporary interest should be the fact that much is being undertaken and achieved in Siberian science, as is well documented by the material pouring into the Library of Congress. — LEON KELSO, WASHINGTON, D. C.

THREE GRASSES APPARENTLY NEW TO MASSACHUSETTS. —

In Rhodora 35: 261,262 (1933), I reported finding a number of interesting adventive plants on the beds of Gray & Cole's Nursery in Ward Hill, Haverhill, Essex County, Massachusetts. In June 1955, I revisited the nursery and found *Poa chapmaniana* Scribn., *Holosteum umbellatum* L. and *Draba verna* L. var. *boerhaavii* Van Hall still persisting after over twenty years. While there, I collected a specimen of what appeared to be *Alopecurus geniculatus* L. but closer examination made me suspect that it might be *A. carolinianus* Walt. Since Hitchcock's Manual of the Grasses did not report the species north of New Jersey, I put the specimen aside for further study. In May 1959 while collecting *Draba verna* in a flower-bed beside a house in Old Deerfield, Franklin County, Mass., I again found the same grass. During a recent trip to Washington I showed the specimens to Dr. J. R. Swallen and he confirmed my identification of *A. carolinianus*. The New Britton and Brown Illustrated Flora lists the species as being found north to Massachusetts but Hitchcock and the 8th edition of Gray's Manual give New Jersey

as the northern limit. The species is not represented in the herbarium of the New England Botanical Club and the most northern collections in the Gray Herbarium are from the vicinity of Philadelphia.

In 1953 and 1954, I collected a number of curious adventive plants including *Scandix pecten-veneris* L., *Anagallis arvensis* L. forma *caerulea* (Schreb.) Baumb. and *Sherardia arvensis* L. growing under bird-feeders in Essex County, Massachusetts. (See Harris, S. K. Bird Feeders, a Source of Adventive Weeds. Bull. Mass. Audubon Soc. 42: 248-250 (1958)). These plants were restricted to the ground under feeders supplied with a seed mixture sold by the Massachusetts Audubon Society. Soon after the Audubon Society changed their source of supply although the mixture was kept the same and since that time no more adventives have appeared. Dr. Swallen identified two small species of *Phleum* found under feeders as *P. arenarium* L. and *P. subulatum* (Savi) Aschers. & Graebn. The former was collected on ballast in New York City by Addison Brown in 1880 and the latter on ballast in Philadelphia by Isaac C. Martindale in 1879. My collections seem to be the first for New England.

Phleum arenarium L. Massachusetts: Essex County, Boxford, *S. K. Harris 8617b* (14 June 1953).

Phleum subulatum (Savi) Aschers. & Graebn. Massachusetts: Essex County, Boxford, *S. K. Harris 8617a* (14 June 1953), *8991* (11 August 1953); Topsfield, *S. K. Harris 9642* (13 July 1954).

Alopecurus carolinianus Walt. Massachusetts: Essex County, Ward Hill, Haverhill, *S. K. Harris 9888* (9 June 1955); Franklin County, Deerfield, *S. K. Harris 19077* (22 May 1959).

Specimens are on deposit in the herbarium of the New England Botanical Club. — STUART K. HARRIS, DEPT. OF BIOLOGY, BOSTON UNIVERSITY.

Volume 62, No. 740, including pages 205-234, was issued August 25, 1960.

REFERENCE LIBRARY

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Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

REED CLARK ROLLINS, Editor-in-Chief

ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
CARROLL EMORY WOOD, JR.
IVAN MACKENZIE LAMB
} Associate Editors

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

Scientific papers and notes, relating directly or indirectly to the plants of North America, will be considered by the editorial committee for publication. Articles concerned with systematic botany and cytotaxonomy in their broader implications are equally acceptable. All manuscripts should be double-spaced throughout. Please conform to the style of recent issues of the journal. Illustrations can be used only if the cost of engraver's blocks is met through the author or his institution. Forms may be closed five weeks in advance of publication. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Avenue, Cambridge 38, Mass.

Subscriptions and orders for back issues (making all remittances payable to RHODORA) should be sent to Albert F. Hill, Botanical Museum, Oxford Street, Cambridge 38, Mass.

Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

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THE RED-FRUITED CROWBERRIES IN NORTH AMERICA

DORIS LÖVE

HISTORY

The first time red-fruited crowberries are mentioned in North American botanical literature seems to be in La Pylaie's (1825) "Notice sur l'île de Terre-Neuve et quelques îles voisines". They were found growing on top of low mountains on Ile Saint-Pierre, later also on Miquelon. Identifying them as *Empetrum rubrum* Willd., La Pylaie stated: "Cette plante est identique avec les échantillons magellaniques conservés dans I'herbier de M. Jussieu" (p. 426, l. c.).

Empetrum rubrum was described by Willdenow (1805) from plants collected along Magellan Straits in South America (map, fig. 1), and distinguished from the Linnean *E. nigrum* by its red fruits, hairy branches and scabrous leaves. Though La Pylaie did not mention that his species had hairy branches, it was later confirmed that such was the case (Fernald & Wiegand, 1913).

In many places in his travelogue La Pylaie stated that ordinary "*E. nigrum*" was abundant and common in Newfoundland, and he never indicated that this species was different from what he already knew from his native France. It also seems that he did not find any red-fruited plants on Newfoundland proper as is indicated on p. 493 (l. c.) :". . . une pelouse composée de l'*E. nigrum* (l'*E. rubrum* a disparu depuis l'île de Miquelon), . . .".

Rafinesque (1838), always eager to disagree and argue, was of a different opinion, however, as to the identity of the red crowberries. He apparently had not seen the actual specimens of La Pylaie, possibly not even read his paper

properly, but had studied a specimen of crowberry with red fruits from "Labrador". No mention is made in the "New Flora of North America" (Rafinesque, 1838) to the collector of this specimen, or from where in "Labrador" it emanated. Describing the specimen, Rafinesque (l. c.) wrote in one place: ". .berry purple. .", in another: "My specimen is from Labrador and has red berries strikingly like those of *Phytolacca*!". Somewhat further on he declared: "My sp. is perfectly distinct, the branches are terete smooth but sulcate among the leaves. . ." (all p. 50, l. c.).

He named his plant *Empetrum purpureum* and made La Pylaie's *E. rubrum* a synonym of this. As area for his new species he indicated all the then known area of "*E. nigrum*" in North America: "Canada, Labrador, New Foundland, White Mts., Lake Superior, near rocky shores". This he did because he quite boldly concluded that all *Empetrum* of this continent should have red fruits, and because he was convinced that Michaux (1803) and "all Am. botanists after him" were wrong in referring the American plants to the black-fruited European *E. nigrum* L.

It seems that Rafinesque, though in part mistaken, nevertheless was aware that the American crowberries were different from typical European *E. nigrum* L. He even suspected that in the European Alps and in Siberia there existed black-fruited plants which approached more closely the American ones than *E. nigrum* L. The characters, mainly leaf-differences, on which he based his assumptions, are, however, not sufficient for a distinction between what we today recognize as the two species *E. nigrum* L. and *E. hermaphroditum* (Lge.) Hagerup. The latter, quite correctly, occurs in the Alps (Favarger, Richard, & Duckert, 1959) as well as all over boreal and arctic North America and Siberia (Vassiliev, 1949; Löve & Löve, 1959). Rafinesque (1838) erred, however, in respect to the color of the fruit: black is predominant in North America, red is rare, and found only in certain areas. But he was right in distinguishing the northern crowberries from the South American *E. rubrum*.

After Rafinesque (1838) the existence of North American red-fruited crowberries seems to have been forgotten during

the rest of the 19th century, with the exception of a brief mention of such plants from Greenland by Durand in 1863

Durand (in Durand, James, & Ashmead, 1863) listed a number of plants from northwest Greenland, collected in 1861 by Dr. I. I. Hayes between the 78th and 82nd parallels. Among these was "*E. rubrum* Willd. (a variety of E. nigrum?)" from Tessuissak. The listing is accompanied by the following foot-note: "Drupe red, stems apparently smaller and more decumbent than in *E. nigrum*, from which it does not otherwise differ. . . . . It is a remarkable fact of geographical botany, that this red-fruited species, originally found on the shores of the Straits of Magellan, should appear again at the opposite extremity of the American continent. Messrs. La Pylaie and Tuckerman met with it in Newfoundland, and, quite lately Abbé Ferland, a Catholic missionary of Laval University of Quebec, found it likewise on the coast of Labrador together with *Empetrum nigrum*." (p. 95, (l. c.).

On this one must comment that it is not known that Tuckerman ever visited Newfoundland (Dr. E. Rouleau, pers. comm.). Abbé Ferland's plants were collected in 1858 at La Tabatière, North Shore of St. Lawrence Gulf in Quebec province not far from the present border of Labrador (Brunet, 1863, 1867). We have not been able to locate this collection, but Fernald (1923) refers it without further explanation to *E. Eamesii*.

As Durand's (1863) list dealt with plants from Greenland, it of course did not concern the scientists dealing with the American flora further south. It seems that we owe the rediscovery of red-fruited crowberries on the American continent and the re-opening of the discussion of their taxonomy to Fernald, who, together with C. H. Knowlton, found such plants on Mt. Saddleback, Maine, in 1894 (Fernald, 1902).

At first Fernald (1902) associated these plants with the Chilean *rubrum*-complex as being identical with *E. nigrum* v. *andinum* DC. (cf. De Candolle, 1869). Later, when he had seen considerably more material from both Newfoundland, Canada, and New England, Fernald together with Wie-

gand (1913) separated the North American ones from the South American and placed the former into two distinct, red-fruited species, *E. atropurpureum* Fern. & Wieg. and *E. Eamesii* Fern. & Wieg. Eames, for whom the Newfoundland

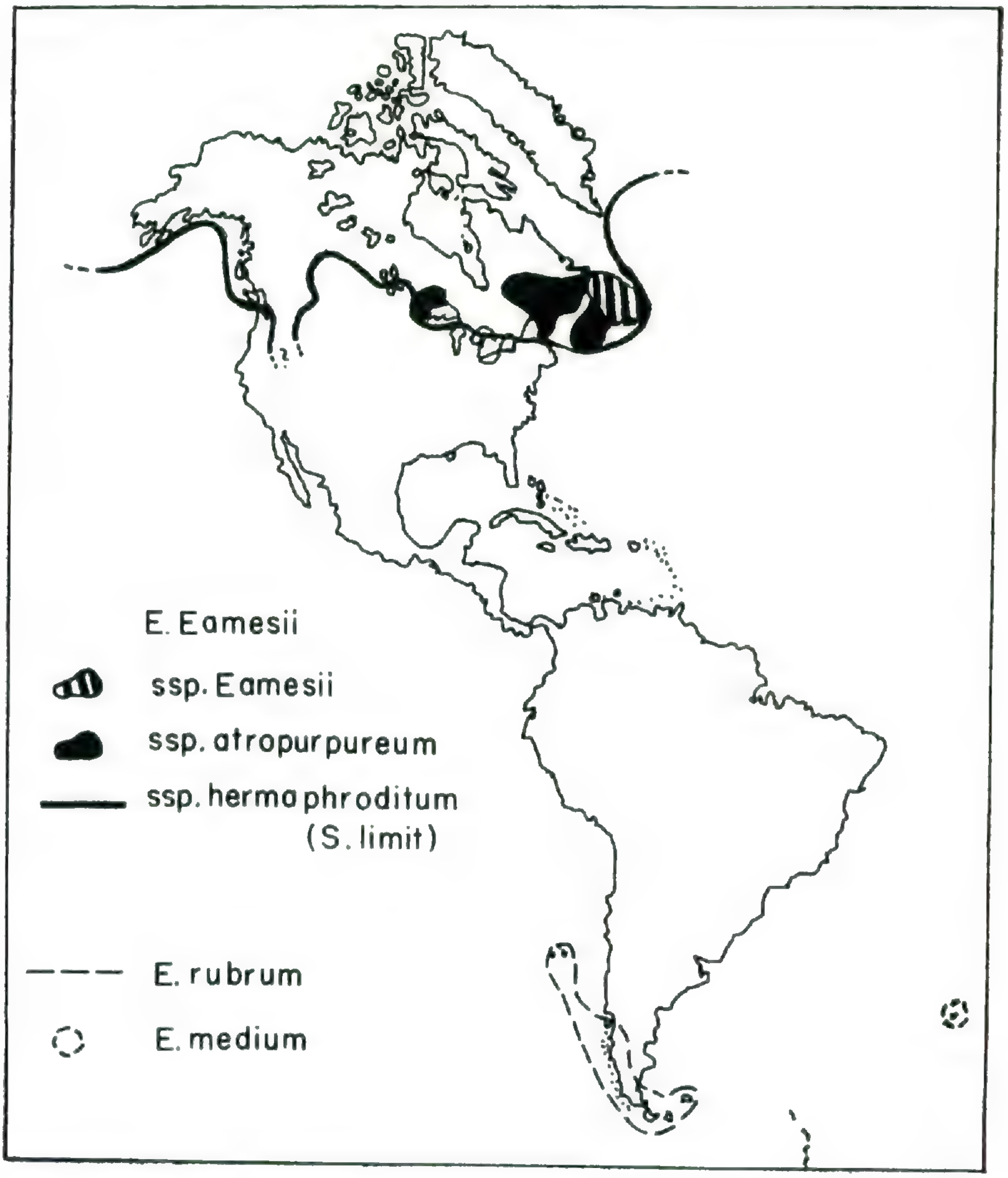

FIG. 1. Map of the distribution in North America of *Empetrum Eamesii* ssp. *Eamesii*, ssp. *atropurpureum* and ssp. *hermaphroditum*, and in South America of *E. rubrum* and *E. medium*.

plants were named, had already pointed out in 1909 that these were quite remote from the South American species, and also, which is very important, remarked that his plants were polygamous (Eames, 1909).

In their paper Fernald and Wiegand (1913) included, though somewhat reluctantly, an arctic *E. nigrum* v. *purpureum* (Raf.) Fern. & Wieg. based upon the records of Rafinesque (1838) and Durand (1863) as well as a report about such plants on Ellesmereland by Simmons (1906).

In spite of the fact that Fernald and Wiegand (1913) had definitely dissociated *E. atropurpureum* and *E. Eamesii* from the South American *E. rubrum* and its varieties, Good (1927) in his large and thorough monograph of the genus *Empetrum* re-established the bond, making *atropurpureum* a variety and *Eamesii* a subspecies of *E. rubrum.* He also mentioned Rafinesque's *purpureum,* partly as a synonym of his ssp. *Eamesii,* partly as a special form of his *E. nigrum.*

It should be noted here that Good (1927) for his *E. rubrum* preferred the author-name "Vahl" instead of "Willd." There seems, however, to be no doubt that Willdenow described this species and is the rightful author of its name (Willdenow, 1805), even if he referred in his description to "*E. rubrum.* Vahl in litt." This remark does not validate Vahl as the author of the species, and we will continue to use the legal and otherwise widely accepted author-name Willdenow.

OBSERVATIONS

Sex of the flowers: Good (1927) made a very thorough study of growth habit, leaf morphology, hairiness, flower structure and fruit color throughout the genus *Empetrum,* but he, as most preceding students of this genus, failed to understand the importance of the sex of the flowers, though he always reported it.

Apparently Linnaeus (1753) knew only the dioecious type of *Empetrum,* but Willdenow (1805) noted that Jacquin had collected hermaphroditic specimens and that he himself had seen one such sheet at Uppsala. De Candolle (1869) stated that *Empetrum* is sometimes dioecious, sometimes monoecious, and that the female flowers carry traces of stamens, the the male flowers rudimentary ovaries (cf. also Hagerup, 1922).

In 1880 J. Lange had already named plants from Greenland as *E. nigrum β hermaphroditum,* but without any description. Warming (1887), Samuelsson (1913), Mentz

(1919), and Hagerup (1927) found plants with bisexual flowers to be common in the Arctic and in northern Scandinavia, the dioecious ones common in more southern regions (cf. also Hagerup, 1922). The existence of hermaphrodites in the Alps (Favarger, Richard & Duckert, 1959) and in northern Siberia (Vassiliev, 1949) has also been amply verified.

Hagerup (1927) was able to take one step further than his contemporaries by studying the chromosomes of the two types of *Empetrum*, and he found that the dioecious plants were diploid with 2n=26, those with hermaphroditic flowers were tetraploid with 2n=52 chromosomes. Because of this Hagerup (1927) described the hermaphroditic form and raised it to specific status, *E. hermaphroditum* Hagerup. Since then, the chromosome number 2n=52 has been confirmed in this species from several localities in Europe and the Arctic (Arwidsson, 1938; Flovik, 1940; Löve, in Arwidsson, 1943; Löve & Löve, 1956; Favarger, Richard & Duckert, 1959) as well as in North America (Löve & Löve, 1959).

It must be noted in this connection that it is quite usual to find polygamous specimens among the tetraploid ones (cf. also De Candolle, 1869; Samuelsson, 1913; Hagerup, 1927; Porsild, 1957; Löve & Löve, 1959) and sometimes, but very rarely, also in the dioecious ones (Samuelsson, 1913; Blackburn, 1938). It seems to this author that this phenomenon occurs more frequently in the southern part of the distribution area of *E. hermaphroditum* than in the really arctic parts of it. Whether this is a sign of instability in the sex determining mechanism or a reaction due to differences in day-length has yet to be established.

Samuelsson (1913) reported on a specimen of *E. nigrum* from Jämtland, Sweden (63° N. Lat.) which in the first year, 1908, after transplantation to Uppsala (59° 45′ N. Lat.) produced male flowers (the flowers are already completed in the buds a season before flowering), but later, in 1910, appeared polygamous with most of the flowers female. Blackburn (1938) found a hermaphroditic, diploid plant in Scotland. As it had three stamens, (six is the more common in true *E. hermaphroditum*; cf. Hagerup, 1927) and further-

more looked morphologically like *E. nigrum*, Blackburn's specimen must be considered as an abnormal form of *E. nigrum*. The development of rudimentary stamens or ovaries (such as found in *E. nigrum*) into functional ones, naturally

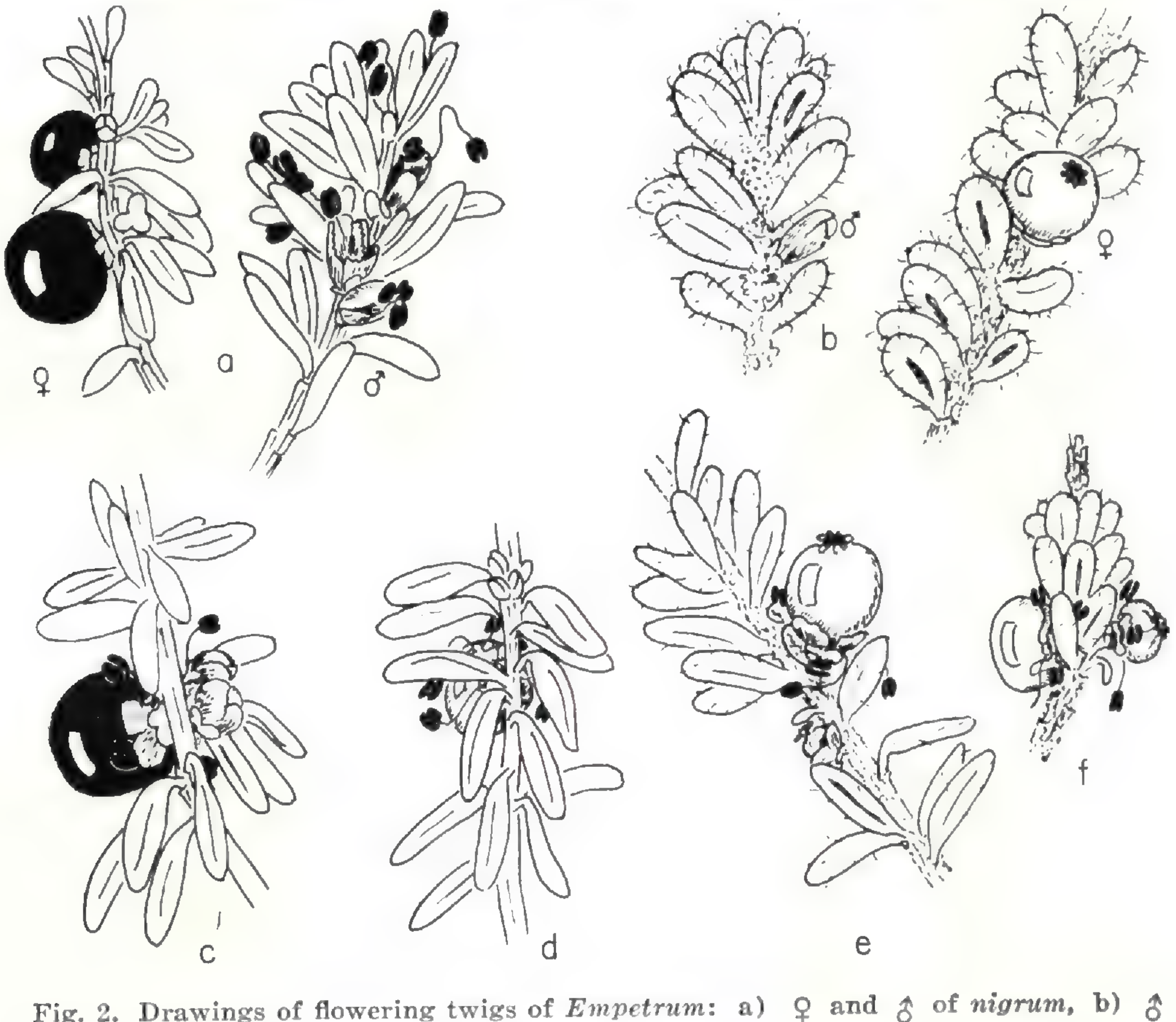

Fig. 2. Drawings of flowering twigs of *Empetrum*: a) ♀ and ♂ of *nigrum*, b) ♂ and ♀ of *rubrum*, c) ☿ of *hermaphroditum*, d) ☿ of "*purpureum*", e) ☿ of *atropurpureum*, and f) ☿ of *Eamesii*.

or after a fungus attack, is not unknown in other dioecious species (D. Löve, 1940, 1942, 1944, 1952).

Both Good (1927) and Hagerup (1927) agreed that the red-fruited South American *E. rubrum* is dioecious, but Good (l. c.) also found "aberrant" specimens with long-petioled, larger, apiculate leaves and brown-hairy stems from Tristan da Cunha and Gough Island to be hermaphroditic (*E. rubrum* Vahl f. *medium* (Carm.) R. Good). Unfortunately, nothing is known regarding the chromosome numbers in the *E. rubrum* complex. If the situation in the Southern Hemisphere parallels that of the Northern, it seems likely that the dioecious and hermaphroditic taxa in the South-

ern Hemisphere should also have different levels of ploidy, and that the hermaphrodites should rather be regarded as a separate species, *E. medium* Carm.

Good (1927) stated further that his *E. rubrum* ssp. *Eamesii* from Labrador, Newfoundland and Saguenay as well as two specimens thereof from Fuegia and Juan Fernandes, "the latter of doubtful color", had unisexual flowers, and that his *E. rubrum* v. *atropurpureum* had unisexual and polygamous flowers (regarding our opinion of the true distribution of *E. Eamesii*, cf. maps in figs. 1 and 5).

The present author has, however, investigated a very large number of herbarium specimens of both *E. Eamesii* and *E. atropurpureum* and found them as a rule to be hermaphroditic (cf. fig. 2), but occasionally polygamous, carrying a number of purely female flowers on the same bush as the hermaphroditic flowers. The specimens of *E. purpureum*, seen by us (fig. 2) and by Dr. J. Lid, Oslo, Norway, have only hermaphroditic flowers.

In the case of polygamy it is often hard to judge from pressed specimens whether the "purely" female flowers have lost their stamens by handling, or after the fruits were ripe, or if they never had any, but opening a number of buds and studying the intact flower has convinced this author that truly female flowers occur on otherwise hermaphroditic specimens. This has been observed in North American red- and black-fruited crowberries (cf. also Löve & Löve, 1959).

In all cases both black- and red-fruited crowberry-bushes from North America carry a multitude of fruits, which is in marked contrast to the few-fruited bushes of *E. nigrum* (pers. observation; cf. also Hagerup, 1927).

Hairiness: Another character which has often been used for associating the North American and South American taxa is the hairiness coating the young twigs and sometimes also the leaves of the red-fruited forms, in contrast to the entirely glabrous twigs and leaves of *E. nigrum* and *E. hermaphroditum* (Willdenow, 1805; De Candolle, 1869; Fernald, 1902; Fernald & Wiegand, 1913; Hagerup, 1927; Good, 1927).

Although *E. nigrum* and *E. hermaphroditum* in the strict sense can be considered essentially glabrous (fig. 2a, c), taxa are known from both species, in their wide sense, which display more or less hairiness at least on the young twigs. Thus, Vassiliev (1949) described three taxa of the *nigrum* complex as hairy: *E. sibiricum* V. Vassil. with young branches more or less covered with reddish or whitish, short, curly hairs; *E. kurilense* V. Vassil. with reddish, curly hairs on the one year old branches; and *E. Kardakovii* V. Vassil. (with *red* fruits, but dioecious) with reddish or whitish, usually curly hairiness. The latter species is found in Kamchatka and around the Bering Sea (cf. Vassiliev, 1949). *E. arcticum*, V. Vassil., of the *hermaphroditum*-group, has twigs "with a red fluff".

In all species of *Empetrum*, the bud scales are normally hairy (pers. observation; Hagerup, 1922, 1927).

As a rule the southern taxa can be considered as hairy (fig. 2b), but in the South American *rubrum*-complex the hairiness tends to vary from glabrescent (*E. rubrum* f. *andinum* (Phil.) Good) to a dense, felty tomentum (*E. rubrum* f. *falklandicum* Good), according to Good (1927).

In most cases the hairs on the leaves of the South American taxa, particularly those along the "leaf corners", are persistent, which is not the case in the northern taxa. *E. Eamesii* and *E. atropurpureum* both have distinctly hairy young twigs, but the sparse hairiness on the young leaves falls off rather soon (fig. 2e, f). The hairiness of the northern taxa is always soft, never scabrous, as indicated for *E. rubrum* by Willdenow (1805).

E. purpureum from Canadian Arctic is always glabrous (pers. observation; also fide J. Lid, Oslo, Norway, for the plants from Ellesmereland).

The leaves: The word "leaf corner" was used above in preference to "margin", as the *Empetrum* leaf has a peculiar structure (De Candolle, 1869; Menz, 1912; Hagerup, 1927). The true, and always hairy, margins meet on what appear to be the underside of the leaf, often giving the impression of a nerve sunk in a crevice (fig. 3). The really abaxial side of

the leaf is, however, enclosed in its protected hollow and carries glands and stomata, whereas the adaxial side has no stomata and is covered by a more or less heavy wax-coating (fig. 4). The wax-coating on the *E. rubrum* leaves studied by this author seems to be much thicker than that on specimens from the Northern hemisphere (fig. 4). Whether this is a persistent feature throughout the *rubrum*-complex is not known.

Studying sections of *Empetrum* leaves from both the Northern and Southern Hemisphere and of black- as well as

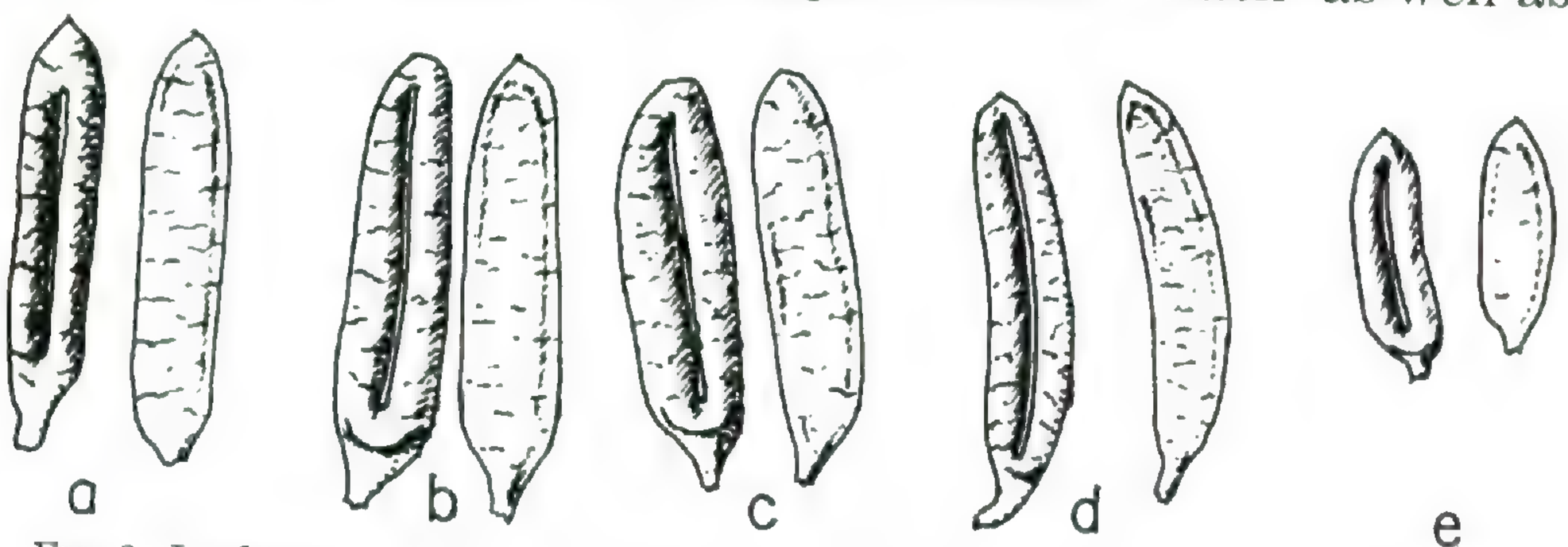

FIG. 3. Leaf-types of some *Empetrum*; left abaxial, right adaxial surfaces of: a) *nigrum*, b) *hermaphroditum*, c) "*purpureum*", d) *atropurpureum*, and e) *Eamesii*.

red-fruited taxa, the author could find no major, significant differences between the structure of the leaves (fig. 4), but some slight variation was noted in the width and firmness of the palisade layer and the thickness of the wax-coating (see above). The *nigrum* leaves (from Scania, Sweden) appeared to have the least well-developed palisade layer and collapsed easily under the pressure of the knife (fig. 4b). The *hermaphroditum* leaf (from Quebec province, Canada) was firmer (fig. 4c) but the relatively oval leaves of *E. rubrum* (from the Falkland Islands) and *E. Eamesii* (from Newfoundland, Canada) were the firmest of them all (fig. 4a, e). All leaves come from herbarium specimens, were soaked and then sectioned.

Good (1927) put a good deal of emphasis on the leaf shape of the various taxa, and so did Vassiliev (1949) in his study of the crowberries of the Northern Hemisphere. Generally it seems to us that the leaves of the Southern Hemisphere taxa are broader than those of the northern taxa, but in this respect *E. rubrum* f. *medium* (Tristan da Cunha, Gough

Island) with its long, narrow and apiculate leaves is an exception in the south, and *E. Eamesii* (Newfoundland and Labrador, Canada) with its short, slightly oval leaf is an exception in the north.

Remarks on the ecology of the red-fruited taxa: Ecologically, *E. Eamesii* seems to prefer dry, exposed slopes and summits of mountains, grows easily over rock and on rock-ledges as

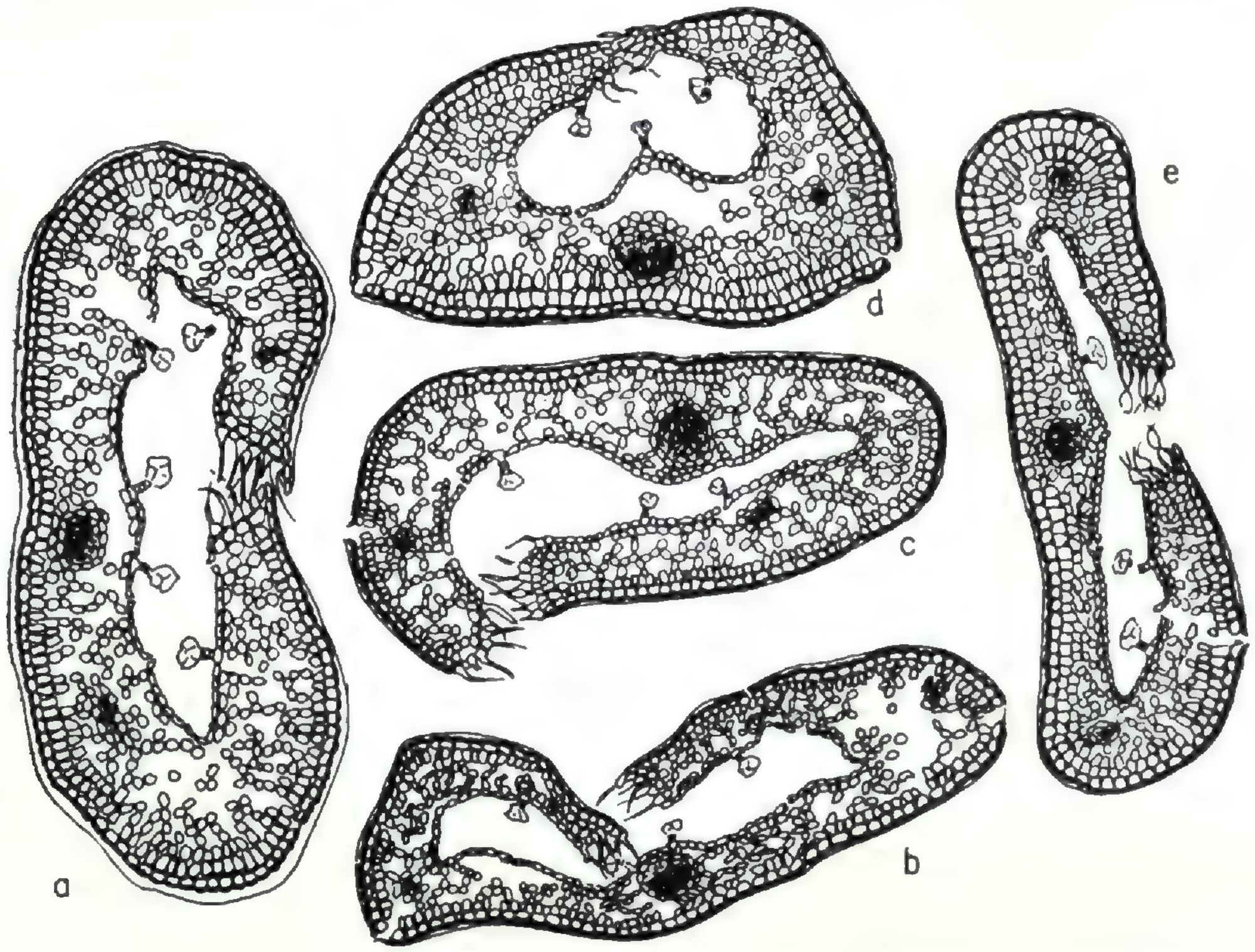

Fig. 4. Leaf-sections of some *Empetrum*: a) *rubrum*, b) *nigrum*, c) *hermaphroditum*, d) *atropurpureum*, and e) *Eamesii*.

well as on fine, angular gravel (La Pylaie, 1825; Eames, 1909; Fernald & Wiegand, 1913; E. Rouleau, pers. comm.) in contrast to the often boggy habitats of *E. hermaphroditum*. Only at Sheffield Lake, Eastern Brook, Green Bay district, Newfoundland (no. 2648, Aug. 1951, Rouleau) was *E. Eamesii* found on sandy beaches. It is closely bunched, with upright branches and forms a dense mat. The yearly shoots are very short, and the whole plant gives a strong impression of compactness. Few other plants mingle in its dense mats.

E. atropurpureum in mountainous areas seems to differ

in the same manner from *E. hermaphroditum*, i. e., in its absence from boggy and swampy areas and its preference for rocky ledges, exposed gravel and schist as well as decomposed granite with very little organic matter (Fernald & Wiegand, 1913). It is often found at or above timberline in high mountains.

On Mt. Washington, N. H., *E. atropurpureum* was collected in July 1959 on "frost-terraces" of loose gravel on the outer edge of the "Alpine Garden" (ca. 5000 ft. alt.) by Dr. M. S. Morrison, Uganda, on a joint excursion with this author and Drs. A. Löve, Montreal, L. C. Bliss, Urbana, Ill., and A. Medwecka-Kornas, Krakow, Poland. There may be a characteristic association of plants on these "frost-terraces" although no particular study was made to determine if this was so when the plants were collected. The *Empetrum* there, however, was noted to form small isolated mats and its branches were flattened against the terrace. This may have been due to wind sweeping up the hillside and may indicate a phenotypic growth-form, but cultivation of the plants would reveal to what degree it is a real genetic character. The trailing habit was also noted in some other herbarium specimens from Mt. Washington (C. G. Boott's Spur, July 1910, Forbes; along the carriage-road, coll. A. S. Pease, 1910; near the cog-railway, June 1941, Rousseau & Dansereau).

E. hermaphroditum on Mt. Washington is also mat-forming but has not been observed as trailing. It is very common on the mountain and is often a member of the relatively well-developed heath on the east- and south-facing slopes at about 5200 - 5700 ft. altitude, usually in the lee of rocks and krumholz. Other members of this community are: e. g. *Ledum groenlandicum*, *Vaccinium gaultherioides* (syn.: *V. microphyllum*, *V. uliginosum* v. *alpinum*), *V. Vitis-Idaea* ssp. *minus*, with smaller amounts of *V. caespitosum*, *V. angustifolium*, *Kalmia polifolia*, and at the lowest alpine levels, some *Betula glandulosa* v. *rotundifolia* (Bliss, pers. comm.; also observations by the author).

Along the shores of the River and Gulf of St. Lawrence, *E. atropurpureum* is often found growing on sand dunes, but also on granite rock (Fernald & Wiegand, 1913; Lewis, 1932), and the same, sandy or rocky, habitats are found in

its coastal area in Nova Scotia and Prince Edward Island. Everywhere it exhibits the loose, trailing growth, but a certain amount of wind pressure is active in all these habitats.

About the habit and ecology of *E. purpureum* we know next to nothing, but most likely it does not differ from that

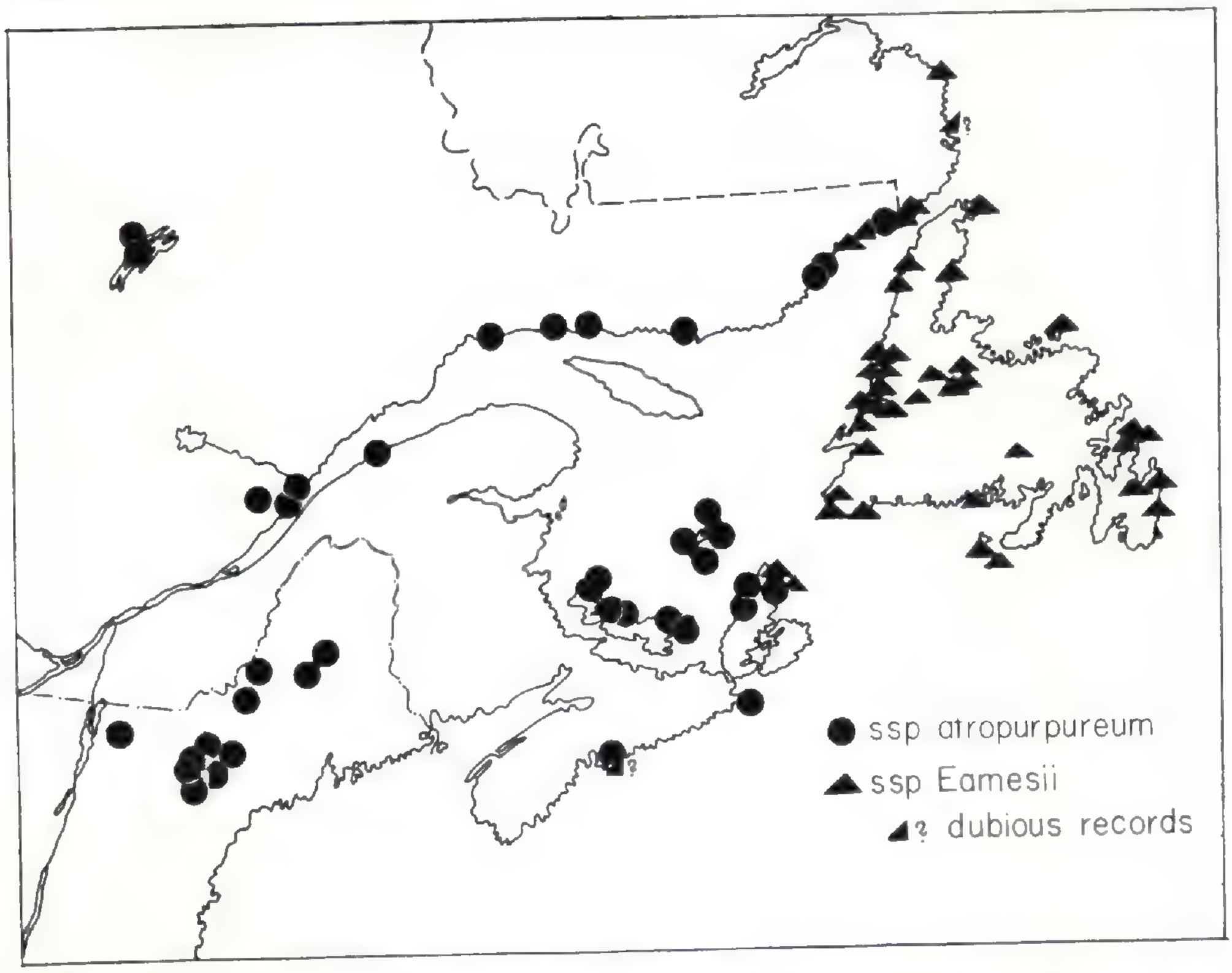

FIG. 5. Map of the distribution in eastern North America of *Empetrum Eamesii* ssp. *Eamesii* (triangles) and ssp. *atropurpureum* (dots). The latter is also found around the western end of Lake Superior in Minnesota and Ontario.

of ordinary *E. hermaphroditum*. Simmons (1906) stated about his collection of red-fruited *Empetrum* on Ellesmereland: "I found this species within a limited area, where, however, it was rather abundant, and, as previously mentioned, covered wide stretches of peaty ground in the valleys, forming together with *Cassiope* and *Myrtillus*, a kind of heath." In its more southern localities it seems to have a preference for rock, similar to that of *E. atropurpureum*. At Bic, Quebec, on the south shore of St. Lawrence River, the habitat was indicated as "rocher" (=rock) for a specimen collected by J. Rousseau, and at Mt. Fortin, Matan Co., Quebec, Fernald and Pease noted as habitat "hornblende schist near the summit about 1100m. (3600 ft.) alt."

Distribution of the red-fruited taxa in North America: The three red-fruited taxa are sympatric with, although ecologically slightly different from, *E. hermaphroditum*, they seem to be fairly well separated geographically from each other (Maps, figs. 5 and 7).

In eastern North America *E. atropurpureum* is found in the Green Mountains of Vermont [Mt. Mansfield, July 7, 1877, C. G. Pringle, and same locality, June 21, 1908, Nellie

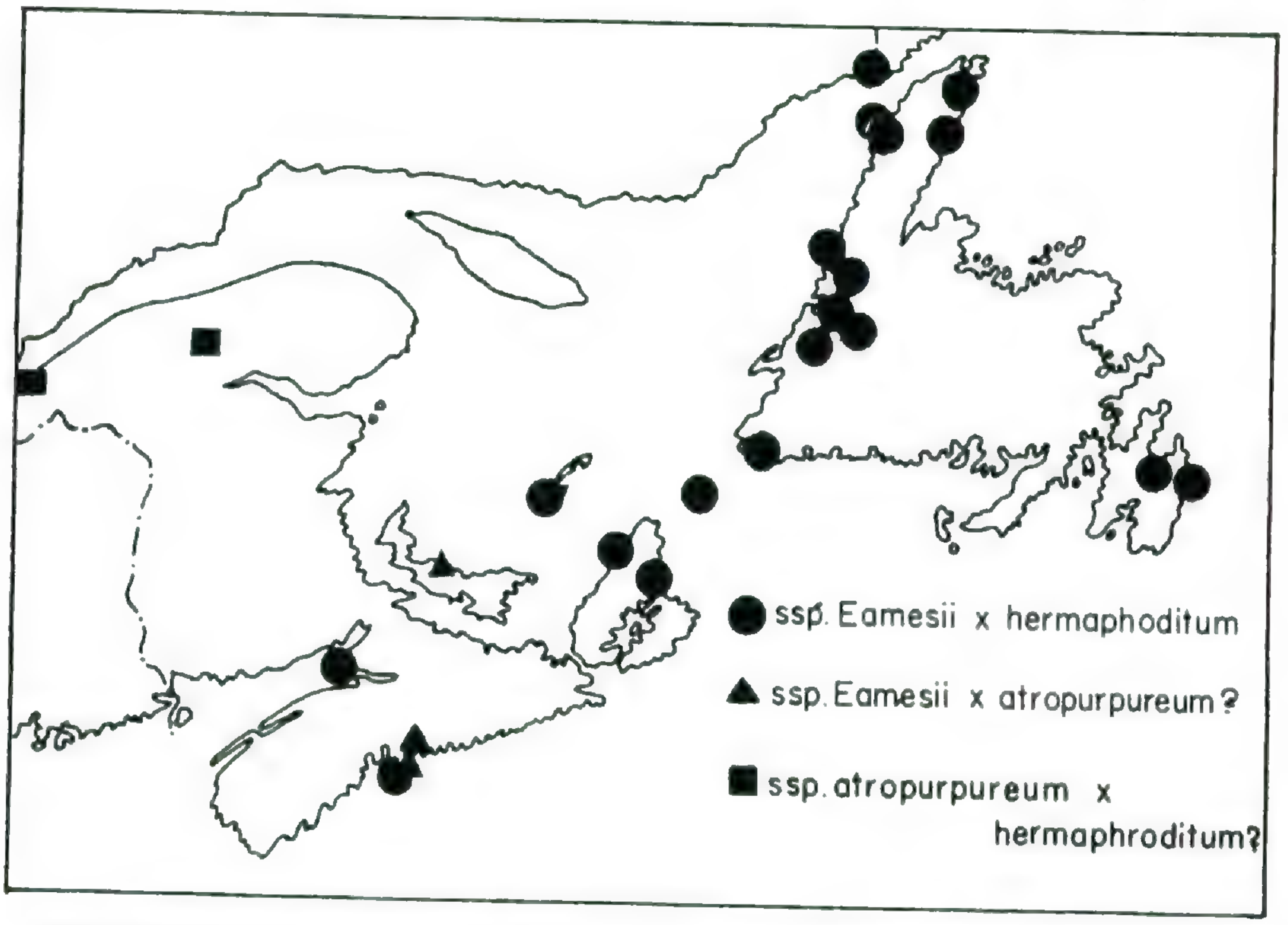

FIG. 6. Map of known localities of hybrids between *Empetrum Eamesii* ssp. *Eamesii* and ssp. *hermaphroditum* (dots), ssp. *Eamesii* and ssp. *atropurpureum* (triangles), and ssp. *atropurpureum* and ssp. *hermaphroditum* (squares).

F. Flynn (the latter was named *E. nigrum*, but is according to H. Vogelmann typical *E. atropurpureum*)]; in the White Mountains of New Hampshire, in the mountains of Maine and adjacent parts of Quebec province (but not on the mountains of the Gaspé peninsula), on both shores of the St. Lawrence River estuary as well as along the Gulf of St. Lawrence (north shore only, not on Anticosti Island), as far east as the border between Labrador and Quebec provinces at Blanc Sablon. Its northernmost localities, almost 250 miles north of the nearest known locality in Quebec province, are found at Lac Mistassini (no. 161, 1944, Rousseau &

Rouleau; no. 2083, July 1946, Rousseau). The absence of localities of *E. atropurpureum* between Lac Mistassini and the North Shore of St. Lawrence is possibly due more to the lack of collections from this area than to a real absence, but this can not be the cause for the absence of this taxon from the Gaspé peninsula and Anticosti Island, both of which have been well investigated by botanists.

This gap seems to continue down over New Brunswick, from which we have seen no collections, or any reports of *E. atropurpureum*. However, it reappears, and is quite common and often collected on Prince Edward Island as well as in the eastern parts of Nova Scotia and Cape Breton Island, and on Iles de la Madeleine (map, fig. 5; Fernald & Wiegand, 1913; Erskine, 1951). So far as we know it is absent from Newfoundland, the French Islands and St. Paul Island.

In central North America, there are a number of localities of *E. atropurpureum* around the western end of Lake Superior both in Ontario and Minnesota: Sailboat Island, Cook Co., Minn. (no. 339, Aug. 1937, Abbe & Abbe) ; Long Island, Twp 63N, R7E, Minn. (no. 517, Aug. 1937, Abbe & Abbe) ; Passage Island, Lake Superior (no. 107, W. S. Cooper in Fernald and Wiegand, 1913) ; Terrace Bay, N. Shore of Lake Superior, Ont. (no. 1168, July 1937, Hosie, Losee, Bannan) ; Heron Bay, N. Shore of Lake Superior, Ont. (no. 723, July 1939, Taylor, Bannan and Harrison). The latter two were collected as *E. nigrum* but later identified as *atropurpureum* by Baldwin. All these specimens look exactly like specimens from eastern U. S. A. and Canada.

The home of *E. Eamesii* is Newfoundland and the French Islands, St. Pierre and Miquelon, where the species is about as common as *E. hermaphroditum* (La Pylaie, 1825; Eames, 1909; Fernald and Wiegand, 1913). Outside this insular area, it occurs on the north coast of the Straits of Belle Isle (several localities in the county of Brouage between 57° and 58° W. Long.; cf. Fernald & Wiegand, 1913, Lewis, 1932), and as far north on the SE shore of Labrador as 53° 27′ N. Lat. (Salmon Bight, no. 50, July 1937, Porsild).

One specimen from Greenland (Mudderbugtsdalen, Disko

Island, 69° 40′ N., no. 392, Aug. 4 - 5, 1937, Porsild) looks superficially very much like an *E. Eamesii*, having hairy branches, small compact leaves densely set on the stems, but it lacks berries. Therefore, Dr. Porsild and this author have

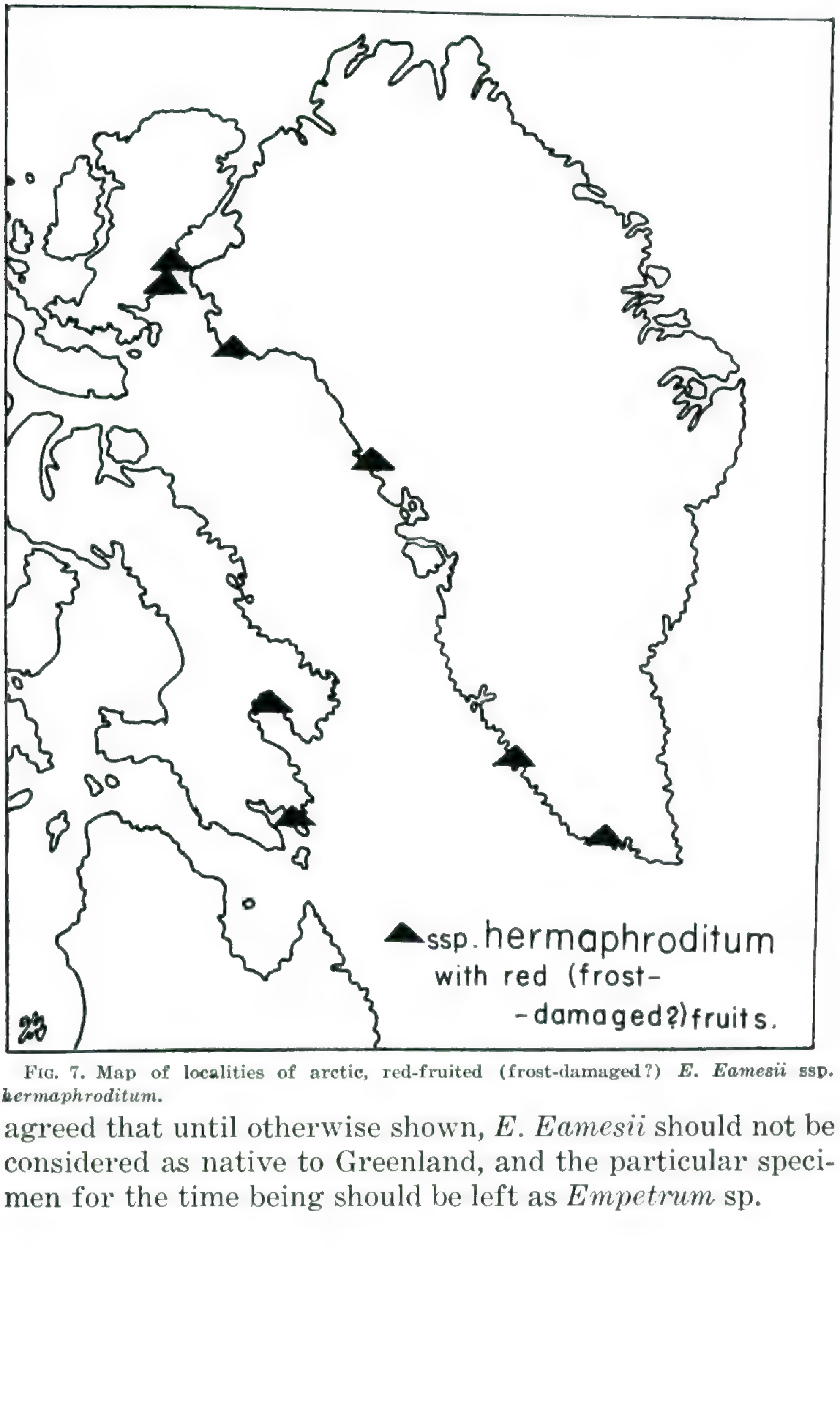

FIG. 7. Map of localities of arctic, red-fruited (frost-damaged?) *E. Eamesii* ssp. *hermaphroditum*.

agreed that until otherwise shown, *E. Eamesii* should not be considered as native to Greenland, and the particular specimen for the time being should be left as *Empetrum* sp.

E. Eamesii occurs also on the northern tip of Cape Breton Island (cf. Erskine 1951), and may possibly reach as far south as near Halifax, Nova Scotia. So far as we know, it has not yet been found on Iles de la Madeleine, or on St. Paul Island in the Gulf of St. Lawrence. For a map of the distribution of *E. atropurpureum* and *E. Eamesii* in eastern North America, see fig. 5.

It is slightly more complicated to define the area for what is purported to be the third red-fruited taxon, "*E. purpureum*", than for the other two. Fernald and Wiegand (1913) regarded it as arctic, but later Fernald changed his opinion both of its area and its taxonomical status. In 1923, he and A. S. Pease found specimens corresponding to Rafinesque's description growing on Mt. Fortin, Matane Co., Quebec. They had purple berries, and were, according to Fernald (1923), completely glabrous. However, we have been able to establish that the young twigs have a very sparse cover of curly brown hairs, and that the young leaves have a number of curly white hairs which seem to disappear soon. Compared to *E. atropurpureum* and *E. Eamesii*, this form can well be termed glabrescent.

Fernald (1923) named these specimens *E. nigrum* f. *purpureum* (Raf.) Fern. and suggested that it was nothing but an occasionally occurring form of *E. nigrum*, and not exclusively arctic.

The latter seems well supported by the discovery of additional specimens from Bic, Quebec (no. 24915, July 1926, J. Rousseau). This locality is on the south shore of the St. Lawrence River and the specimens are very similar to those collected by Fernald and Pease, having purplish fruits, a few white hairs on the youngest leaves, and some brown curly hairiness on the new twigs. Both the specimens from Bic and Mt. Fortin are hermaphroditic, and give an impression of being intermediate between *E. atropurpureum* and *E. hermaphroditum* (cf. map, fig. 6).

With the above mentioned collections in mind, it may be permissible to conclude that the "specimen from Labrador" on which Rafinesque (1838) based his description of *E. purpureum* originated from somewhere along the northern coast

of the Gulf of St. Lawrence, possibly from the present Quebec province, rather than from the truly arctic or sub-arctic parts of Labrador.

In the Herbarium of the Botanical Garden, Montreal, there is, however, a collection named *E. nigrum* f. *purpureum* from a truly arctic locality (Pangnirtung, Baffin Island, no. 1500, Sept. 1936, Dutilly), and another specimen with the same name is found in the herbarium of the Academy of Sciences, Philadelphia (York Sound, Frobisher Bay, 62° 35′ N., 66°30′ W., no. 862, July 1937, E. Perot Walker). These specimens do not seem to differ from those collected by Simmons on Ellesmereland (Simmons, 1906). His specimens are found in Oslo, Norway (no. 883, ad Cape Viele sinus Hayes Sound, Ellesmerelandiae orientalis, 4.VII.1899; no. 850, ad Twin Glacier Valley, sinus Hayes Sound, Ellesmereland orientalis, 6.VII.1899; both: leg. et det. Herman G. Simmons). Dr. J. Lid, Oslo, Norway, has given us the following information about them: Specimen no. 883 is flowering, but no. 850 has both flowers and berries. Both are hermaphroditic, glabrous and the fruits are shiny and red. Both sheets were revised in 1934 by Dr. Th. Arwidsson, Stockholm, Sweden, to "*E. hermaphroditum* (Lge.) Hagerup f. *purpureum* (Raf.) ?" The transfer has not been published.

Dr. A. E. Porsild, National Museum, Ottawa, has told this author in a letter that he has "from time to time picked up red-fruited specimens in various parts of the Arctic." Such red-fruited specimens do not only exist on the Canadian side of the Smith Sound - Baffin Bay - Davis Strait area, but also in Greenland. The National Museum, Ottawa, has the following collections: Danmark Havn, 76°45′ N., July 16, 1908, Lundager; Godthaab, 64°11′ N., June 25, 1930, Eugenius; Neria, 61°33′ (three collections) a) July 16, 1930, b) July 2, 1924, c) July 4, 1926, Eugenius. All these collections have shiny red berries, are hermaphroditic, and have glabrous twigs. A fourth collection from Neria (June 26, 1927, Eugenius) is normal *E. hermaphroditum* as in the rest of Greenland.

In the Herbarium of the Academy of Sciences, Philadelphia, there is an old specimen from Greenland, which may

refer to some of those seen by Durand (1863) : Port Foulke, Dr. Kane's Expedition to the polar region, Sec. A. N. S. Vol. 3. — N. S. n° 3, det. (as *E. nigrum*) I. I. Hayes. This specimen has no berries but differs in no way from ordinary *E. hermaphroditum*.

Both in a letter to the author and in personal conversation with her, Dr. A. E. Porsild, Ottawa has expressed his view that the red berries of these specimens may be the result of frost-bite or some disease, rather than a truly genetic character. A support for this theory may be found in a collection from Baffin Island (Cape Dorset, 64°10′ N., 76°20′ W., July 3, 1926, Soper), which appears to be partly frost-bitten, and which on the damaged side has exactly the kind of red, shiny, small berries as seen in the above-mentioned arctic specimens, but on the other half, fresh and green, has ordinary sized, bluish-black berries.

There seems thus to be some doubt about the true area as well as the true identity of what is named *E. purpureum*. A map, fig. 7, indicates the arctic localities mentioned above.

Hybrids between red- and black-fruited taxa: Strong evidence for an association of the red-fruited northern taxa with the *hermaphroditum*-complex rather than with the *rubrum*-complex is the fact that hybrids occur between them and *E. hermaphroditum*. The hybrids have either black, dark purple (most common) or purple fruits and are intermediate or approach one parent more or less in characters such as leaf size, hairiness and growth habit.

Fernald and Wiegand's (1913) description of *E. atropurpureum* is actually so broad, especially regarding fruit-color ("rubris vel atropurpureis opacis"), that most likely some hybrids between red-fruited and black-fruited plants fall into the group of dark-purplish-fruited ones. Thus it is rather hard to judge where the actual limit between the true *E. atropurpureum* and the hybrid between it and *E. hermaphroditum* should be drawn. There is probably a certain amount of introgression between the two, at least in Maine and New Hampshire.

On Newfoundland the situation is more clearcut, and several localities have yielded plants of distinct hybrid appear-

ance between *E. Eamesii* and *E. hermaphroditum* as well as many others showing signs of introgression between the two taxa (Table I). From the mainland north of Newfoundland on the border between Quebec and Labrador at Blanc Sablon two sets of hybrids have been collected (nos. 113 and 114, Aug. 1939, Brunel; cf. Table I), and it is interesting that at the time of collection, according to the label on sheet no. 113, a note was made: "Feuillage de *E. Eamesii.* Fruits: couleur de *E. nigrum,* goût de *E. Eamesii* (fide H. Lewis)". Another hybrid, at Venison Tickle, Labrador, (no. 13719, 1896, Waghorn) was collected under the name *E. nigrum,* but later redetermined first to *E. Eamesii,* then to *E. atropurpureum.*

Also south of Newfoundland a few hybrids between *E. Eamesii* and *E. hermaphroditum* have been discovered and are represented in the herbaria (cf. Table I) from localities on Cape Breton Island. They are all in the vicinity of both parent species.

On Iles de la Madeleine, in the Gulf of St. Lawrence (no. 9406, Ile Havre-Aubert, Marie-Victorin and Rolland-Germain) and on St.. Paul Island (no. 53554, Aug. 1953, Erskine) specimens have been collected which have dark fruits, but leaves strikingly like those of *E. Eamesii.* However, so far as we know, no pure *E. Eamesii* has been collected or reported from any of these islands, but both *E. atropurpureum* and *E. hermaphroditum* are found there. It is not completely excluded that also *E. Eamesii* could exist there, but is rare and has escaped attention from botanists. A long range dispersal of pollen of *E. Eamesii* from either Newfoundland or Cape Breton Island to these islands does not seem reasonable, but hybrid berries and seeds could possibly have been carried by birds over these relatively short distances.

All the above-mentioned hybrids, usually named *E. nigrum* by their collectors, are hermaphroditic or, rarely, polygamous with a few female flowers on the same bush as the hermaphroditic.

A map of the known localities of the hybrids between *E. Eamesii* and *E. hermaphroditum* is given in fig. 6.

Hybrids between red-fruited taxa: Only two areas are known where *E. Eamesii* and *E. atropurpureum* overlap. One is on

the north shore of Belle Isle Strait on the border between Canada and Labrador (see map, fig. 6) but from this area we have so far seen no material that shows any sign of hybridity between the two red-fruited taxa.

The other point of contact seems to be on the northern tip of Cape Breton Island, from where specimens are known of both *E. atropurpureum* (several collections) and *E. Eamesii* (Lockhart Brook, Salmon River, Victoria Co., no. 6356, July 1952, Smith Taylor, Webster Slipp; Ingonish

TABLE I.

List of specimens showing hybrid traits between *Empetrum Eamesii* ssp. *Eamesii* and ssp. *hermaphroditum*. MT=Herbarium of the University of Montreal, OTT=National Museum, Ottawa, DAO=Department of Agriculture, Ottawa, PH=Academy of Natural Science, Philadelphia. **Labrador**: Venison Tickle, no. 13719, Waghorn, 1896 (OTT). **Quebec:** Blanc Sablon, nos. 113 & 114, Aug. 1939, Brunel (MT). Iles de la Madeleine, Ile Havre-Aubert, no. 9406, Marie-Victorin and Rolland-Germain (MT). **Newfoundland**: St. Anthony, Cremailliere Bay, no. 3029, Sept. 1951, Saville (DAO). St. John's Island, no. 4122, Aug. 1955, Rouleau (MT). Roddickton, Cloud Hills, no. 4619, July 1958, Rouleau (MT). Sally's Cove, Martin Point, no. 4766, July 1958, Rouleau (MT). Main Arm, Bonne Bay, July 1922, Fernald, Long, Fogg (MT). Killdevil Mt., Bonne Bay, no. 185, Aug. 1929, Fernald, Long, Fogg (PH). Mt. Musgrave, no. 392, Aug. 1948, Rouleau (MT). Stag Hill Brook, no. 1187, Aug. 1950, Rouleau (MT). Taleville, no. 4531, July 1958, Rouleau (MT). Trinity Bay, Old Perlican, no. 42, Aug. 1914, Torrey (OTT). St. John's, no. 150, Aug. 1894, Robinson & Schrenck (MT, OTT). Dog Peninsula, St. Margaret Bay, no. 28648, Aug. 1925, Fernald, Wiegand, Long, Gilbert Jr., Hotchkiss (PH). Port aux Basque, no. 26820, July 1924, Fernald, Long, Dunbar (PH). **Nova Scotia**: St. Paul Island, no. 53554, Aug. 1953, Erskine (DAO). Ciboux Island, Victoria Co., no. 10930, July 1954, Smith, Taylor, Schofield, Webster, Slipp, Bentley (DAO). Lockhart Brook, Salmon River, Vict. Co., no. 5358, July 1952, Smith, Taylor, Webster, Slipp (DAO). Spicer's Cove, Cumberland Co., no. 4846, June 1954, Bentley, Schofield (DAO). Sambro, Halifax Co., no. 26, Aug. 1940, Dore (DAO).

Barrens, Victoria Co., no. 4612, July 1951, Smith, Schofield, Sampson, Bentley). From this area no hybrids have been noted so far, but from further south, some obvious ones have been seen.

Some specimens, named as *E. Eamesii* by the collectors, from Halibut Cove, Halifax Co., Nova Scotia (nos. 45526 and 45528, July 1945, Dore, Senn, Gorham) and from Sambro, Halifax Co., (no. 27, Aug. 1940, Dore) are rather aber-

rant from *E. Eamesii* as otherwise known. Their leaves are much longer and narrower than ordinary in *E. Eamesii* and remind one much more of *E. atropurpureum* leaves, but they are densely arranged on the stem, and all directed upwards as is common in *E. Eamesii.* The young twigs are lanate and the fruits are light pink, the latter fact also noted on the sheet by Dr. W. G. Dore of Ottawa. In growth habit they are all intermediate between the loose, trailing type of *E. atropurpureum*, and the more compact type of *E. Eamesii.*

The same characters are found in a specimen from Stanhope, Queen's Co., Prince Edward Island (no. 45322, June 1945, Dore & Gorham). Also in this case Dr. Dore has noted the remarkably intermediate traits on the determination label.

TABLE II.

List of specimens showing hybrid traits between *Empetrum Eamesii* ssp. *Eamesii* and ssp. *atropurpureum.* **Nova Scotia:** Halibut Cove, Halifax Co., nos. 45526 & 45528, July 1945, Dore, Senn, Gorham (DAO). Sambro, Halifax Co., no. 27, Aug. 1940, Dore (DAO). **Prince Edward Island:** Stanhope, Queen's Co., no. 45322, June 1945, Dore, Gorham (DAO).

All of the above-mentioned specimens can hardly be anything but hybrids between *E. atropurpureum* and *E. Eamesii.* The map in fig. 6 shows the localities. The specimens are listed in Table II.

DISCUSSION AND TAXONOMICAL REVISION

Reviewing what has been said above we find that the basis for a relationship between the North American red-fruited taxa and the South American *E. rubrum*-complex consisted of similarities in fruit-color, hairiness, and, in one case, leaf-shape (Good, 1927).

Our own reasons for establishing a bond with the *E. hermaphroditum*-complex instead are based upon the facts that the red-fruited, North American taxa are sympatric with *E. hermaphroditum*, are hermaphroditic (or polygamous) like it, and seem to hybridize with it. These facts appear to us a better foundation on which to build an understanding of relationship than mere similarities in morphological characters.

We do not know yet whether it is possible to cross the red-fruited North American taxa with the South American ones,

but since at least the majority of the latter are dioecious, there ought to be as effective a barrier as that between the dioecious, diploid *E. nigrum* and the hermaphroditic, tetraploid *E. hermaphroditum*. In addition, the disjunction of the Southern and Northern Hemisphere taxa must have occurred in a geologically remote period, and Fernald's somewhat over-enthusiastic idea of a preglacial, cold-period, mountain-top-migration of the red-fruited taxa from New England down to Chile (Fernald, 1902) must be discarded as completely unrealistic. Most likely Fernald himself dropped this idea; at least he never again mentioned anything regarding the migratory tendencies of *Empetrum*.

Actually *Empetrum* disperses very slowly. The seeds are difficult to germinate and require several months to several years in the ground before they will develop. Their germination rate, whether before or after passage through an animal, is very low (Hegi, 1908; Hagerup, 1922). The vegetative shoots grow only 10 to 15 cm. per year as measured in Denmark (Hagerup, 1922), 3 to 4 cm. per year in Greenland (Menz, 1912), and probably not much more elsewhere. Individual plants can, however, cover a considerable area, and stems up to 80 (Hegi, 1908) and 140 (Good, 1927) years old have been reported.

It is much more likely that the red-fruited taxa in the Northern Hemisphere are the result of an independent, but much later occurring evolution only grossly comparable to that in the Southern Hemisphere. In both cases, independent genes for fruit-color, hairiness and habit could have mutated, but it is also possible that a whole group of genes, involving all these characters could have been affected at once (cf. Good, 1927). However, since at least in the Northern Hemisphere, we have various degrees of change (fruit-color, hairiness: *E. atropurpureum;* fruit-color, hairiness and leaf-shape: *E. Eamesii*), it seems that here several mutations involving different genes might have taken place independently in time and space.

It is tempting to relate the existence of the red-fruited taxa, as they occur in northeastern North America, to the events of the Pleistocene Ice Age. Such a correlation might be made in view of the relatively restricted areas where al-

most no overlapping occurs as in the case of *E. Eamesii* and *E. atropurpureum*. The former may have appeared rather late (before or during the Wisconsin glaciation?) in Newfoundland, and barely have had time to gain a foothold on the mainland, whereas the latter might have had its origin south of the ice rim (or have been pushed south with the boreal flora in front of it? cf. the disjunct area New England—Minnesota.), and later been able to follow it somewhat northward as the ice withdrew.

In the case of the three taxa, *E. hermaphroditum*, *E. Eamesii* and *E. atropurpureum*, there is no doubt that they are closely related, especially since they seem to hybridize freely. They cannot, in spite of certain differences in fruit-color, habit and area, be regarded as distinct species, but must be fused into one single species as three separate subspecies (Du Rietz, 1930). Biologically, the wide-spread, black-fruited, hermaphroditic taxon must be regarded as the taxon from which the two red-fruited taxa have developed. It would be nice if the oldest name applied to this primitive group. However, of the three taxa in question *E. Eamesii*, as well as *E. atropurpureum*, were both recognized and described at the specific level (Fernald & Wiegand, 1913) at an earlier date than *E. hermaphroditum* (Hagerup, 1927). Therefore one of the two first-mentioned names must designate the species (according to article 57, International Code of Nomenclature, 1956). We are free to choose between the names of the two red-fruited taxa, as both were published on the same date and on the same page (cf. article 58A, recommendation 3). Therefore, we are selecting *E. Eamesii* Fern. & Wieg. as the species name both because it designates a well delimited taxon and because the name is noncommital as to morphological characters.

The following nomenclatural revision is made in conformity with the International Code of Nomenclature:

EMPETRUM EAMESII Fernald & Wiegand

1. **E. Eamesii** Fernald & Wiegand ssp. **Eamesii**

E. rubrum sensu La Pylaie in Terrae-Novae; *E. rubrum* Vahl ssp. *Eamesii* (Fern. & Wieg.) R. Good.

2. **E. Eamesii** Fernald & Wiegand ssp. **atropurpureum** (Fernald &

Wiegand) D. Löve stat. nov. based upon *E. atropurpureum* Fern. & Wieg. in Rhodora 15: 215. 1913. *E. rubrum* Vahl var. *atropurpureum* (Fern. & Wieg.) R. Good.

3. **E. Eamesii** Fernald & Wiegand ssp. **hermaphroditum** (Hagerup) D. Löve stat. nov., based upon *E. hermaphroditum* Hagerup in Dansk Botanisk Arkiv 5 (2): 14. 1927. *E. nigrum* L. β *hermaphroditum* Lange nom. nud.; *E. nigrum* var. *hermaphroditum* Sörenson.

The situation is difficult as regards the so-called "*E. purpureum*", especially because the application of this name remains obscure. It seems possible that the plants which Rafinesque (1838) had in mind were of the type collected later by Fernald and Pease on Mt. Fortin, Quebec (Fernald, 1923), and by Rousseau at Bic on the St. Lawrence River estuary south shore, and which can possibly also be found in other places, including southern Labrador, along the Gulf of St. Lawrence. In this case it is most probable that these plants were the result of hybridisation between e. g. ssp. *atropurpureum* and ssp. *hermaphroditum* (map, fig. 6). This explanation can not, however, be used to explain the existence of purported "*E. purpureum*" in Baffinland, Ellesmereland or Greenland (Durand, 1863; Simmons, 1906; Porsild, pers. comm.; own observations). Neither is there a reason to believe that the plants which we here have referred to as "*E. purpureum*" have a disjunct area split in two by e.g. the Wisconsin glaciation. A hypothesis that the red fruits of the arctic plants are the result of damage by frost, as proposed by Dr. A. E. Porsild, Ottawa, in a discussion with this author, seems to us the most likely one in case of the northern plants (map, fig. 7).

Rafinesque (1838), in describing the fruits of his "*E. purpureum*" used the word "red" as well as "purple", but also indicated that the "red" color was that of *Phytolacca*, the fruits of which certainly have a purplish hue (cf. Fernald & Wiegand, 1913; Fernald, 1923). It is therefore likely that his plant did not belong to the arctic type with shiny red fruits, looking as if they were polished. The arctic plants may still belong to a race occurring around the Smith Sound — Davies Strait area, which responds to frost with a color change of its fruits, but till established that this is so, they are better regarded as monstrosities of ssp. *hermaphroditum*.

Both because of its generally vague application and because the name has more than once been applied to heterogeneous material (in one case to a suspected hybrid, in another to a monstrosity) the name *E. purpureum* Raf. must be rejected on basis of articles 63, 65 and 67, International Code of Nomenclature, 1956.

The following key may be used to identify the taxa discussed above:

A. Plants hermaphroditic, or polygamous with bisexual and female, rarely male, flowers on the same plant.....B.
  B. Fruits red or purplish; young twigs densely white-hairy....C.
    C. Fruits bright red, opaque; leaves short, ca. 2.5 - 4 mm. long, oval, crowded, erect or ascending..... *E. Eamesii* ssp. *Eamesii.*
    C. Fruits dark red or purplish, not opaque; leaves long, ca. 4 - 6 mm., linear, ascending or soon divergent, not crowded..... *E. Eamesii* ssp. *atropurpureum.*
  B. Fruits black, often with a bloom; leaves long-linear, soon reflexed; young twigs glabrous or with a short brownish fuzz..... *E. Eamesii* ssp. *hermaphroditum.*
A. Plants with male or female flowers on separate plants; fruits black, often with a bloom; twigs glabrous; leaves long-linear, soon reflexed..... *E. nigrum.*

Acknowledgements: During the course of this study the author has enjoyed the interest and co-operation of many friends and colleagues for which I am very grateful. Special gratitude is extended to Dr. Ernest Rouleau, Montreal, for much fruitful discussion and for putting his rich Newfoundland collections at my disposal. Among others who have contributed in various ways I would like to mention especially: Dr. L. C. Bliss, Urbana, Illinois; Dr. T. W. Böcher, Copenhagen, Denmark; Dr. W. G. Dore, Plant Research Institute, Ottawa; Dr. C. Favarger, Neuchatel, Switzerland; Dr. J. Lid, Oslo, Norway; Dr. A. Löve, Montreal; Dr. M. S. Morrison, Kampala, Uganda; Dr. A. E. Porsild, National Museum, Ottawa; Dr. R. C. Rollins, Gray Herbarium, Harvard University, Cambridge, Massachusetts; and Dr. H. W. Vogelmann, Burlington, Vermont. I am also indebted to the National Research Council of Canada for making this study possible; for assistance during my visits to Mt. Washington, New Hampshire, I thank the Mount Washington Summit House Inc., its President, Col. Arthur S. Teague, and the management of the Summit Hotel.

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BUNIAS ERUCAGO IN VIRGINIA. — The toothed pod mustard, *Bunias erucago*, L. (Cruciferae) which has not been recorded in North America since 1877 has been collected in May 1957 and 1959 in an isolated field in Prince Edward County of the central Virginia Piedmont. Hegi (Illustrierte Flora von Mittel-Europa 4:472-475) reports it as a weed in central Europe, seed of which often appears as an adulterant in seed of sainfoil, *Onobrychis sativa* Scop. Specimens in fruit were sent in by E. F. Striplin, Agricultural Agent for Prince Edward County (now retired) in May 1957. It was readily determined as belonging to the genus *Bunias*. Current manuals described only *B. orientalis*, L. with which the specimen at hand did not agree.

The fruit characteristics of the two species are very distinctive. *B. erucago* has 3 to 4 ridges of thin flat teeth. In a sense the fruit may be said to be 4 winged. *B. orientalis* is not so ridged, but verrucose.

Specimens were sent to the late Dr. S. F. Blake and to R. C. Rollins (Rollins was away), Blake identified the specimen as *B. erucago*, L. and later Rollins concurred and stated that the only N. A. specimen in the Gray Herbarium is that of I. C. Martindale from the Centennial Exposition Grounds, Philadelphia in June 1877.

*Bunias i*s placed by Gleason in the tribe Euclideae of the family Cruciferae. The characteristics of *B. erucago* are:

Plant biennial, 40 cm or more high, freely branching; stems pubescent below with simple or branched hairs some of which may be purplish; plant abundantly glandular with short stalked glands; lower leaves large, pinnately lobed, sometimes lyrate, upper linear with toothed margins; petals yellow, spatulate; fruit bur-like 0.8-1 cm long, indurate, indehiscent, 3-4 celled with indurate septa, slender pointed by firm persistent style, surface armed with 4 lines of broad thin teeth or "4 winged"; flowers in early May. Specimens have been deposited in the Gray and National Herbaria. — A. B. MASSEY, — VIRGINIA POLYTECHNIC INSTITUTE, COOPERATIVE WILDLIFE RESEARCH UNIT.

CURLYGRASS IN NEW YORK STATE. — During a recent collecting trip through the eastern tip of Long Island, my son, Andrew R. Moldenke, called me to a small cranberry bog near Montauk, Suffolk County, to show me a large stand of curly-grass *(Schizaea pusilla)*. He collected material of it under his collection no. 38, dated July 23, 1960.

Fernald, in the 8th edition of "Gray's Manual of Botany" (1950), gives the distribution of this plant as "Nfld. and N. S.; Pine Barrens of N. J.". Gleason, in the "New Britton and Brown's Illustrated Flora" (1952 & 1958), records it from Newfoundland, Nova Scotia, Goose County, Ontario, and New Jersey.

It would appear, therefore, that this New York station is worthy of note. The plant was growing in association with cranberry, three species of sundew (*Drosera intermedia*, *D. rotundifolia*, and *D. filiformis*), and marsh St. Johnswort (*Triadenum virginicum*). — HAROLD N. MOLDENKE.

Volume 62, No. 741, including pages 235-264, was issued October 13, 1960.

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RHODORA

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

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Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 62 November, 1960 No. 743

THE GENUS XYRIS IN FLORIDA

ROBERT KRAL

The genus *Xyris* L. is represented in the United States by only one of its three sections, the section *Xyris*. The species of sect. *Xyris*, with the exception of *Xyris flexuosa* Muhl. ex Ell., are plants of moist or wet habitats. A number of species are extremely abundant upon the vast expanses of marsh, bog, and savanna afforded by the Florida lowlands. Some of the species are frequently weedy, and are aspect dominants wherever stretches of moist sands are exposed by retreating lake or pond margins, roadside ditch construction, burning, or the bulldozing of flatwoods habitats. Others abound in relatively undisturbed marsh and savanna country, often forming there solid stands on peat-muck or in shallow water. Little economic importance has been attributed to any of the species, yet fruiting spikes of *Xyris* are a significant part of the summer diet of the wild turkey in southern Florida.

The taxonomic treatments of North American *Xyris* have been, for the most part, confined to various regional studies. Chapman (1860) described the largest number of species whose types are all from Florida. Ries (1892), in treating the genus for North America, included fourteen species, illustrating some by cursory drawings of bracts and lateral sepals. Small (1933), in the last edition of the Manual of the Southeastern Flora, treated twenty species, listing all but two from Florida. Malme (1937), in the most comprehensive recent treatment of the section *Xyris*, treated all of the species included by Small, reduced two to synonymy, and described two new varieties. Since the work of Malme,

which was based entirely upon the use of herbarium material, no comprehensive revision of *Xyris* has been done. However, some of the species have been studied by Fernald (1950), Gleason (1951), and Blomquist (1955). The work of Blomquist (1. c.) is particularly useful because it contains careful considerations of vegetative characters underemphasized in all other treatments save that of Fernald.

A principal objective of the present study was to determine whether a further evaluation of the vegetative characteristics and habitat requirements of *Xyris* could provide the means for a ready field identification of the species. Field work was begun on the genus during the summer of 1957 while the writer was in the employ of the Florida Game and Fresh Water Fish Commission. The study was continued during the fall of that year and through the summer of 1958. During this time over 1500 specimens were examined, including the *Xyris* collections of the Herbarium of the University of Florida. Later, in the early part of 1960, the author was pleased to receive on loan material of all Florida *Xyris* from the New York Botanical Garden and from the Gray Herbarium, Harvard University. This work would not have been possible were it not for the kind assistance and encouragement of Dr. Robert K. Godfrey[1] of Florida State University, Miss Lillian Arnold and Professor Erdman West of the University of Florida, and Mr. George R. Cooley, Research Fellow of the Gray Herbarium. Their help is hereby gratefully acknowledged.

Toward the end of the project it became obvious that most of the Florida *Xyris* could be readily identified by the vegetative features. Fifteen entities are treated below; fourteen are of specific rank, one a geographical variant. The known range of two (*X. drummondii* Malme, *X. scabrifolia* Harper) did not hitherto include Florida; they were previously known only from Alabama and Georgia respectively.

MORPHOLOGY

DURATION. Blomquist (1955) has stated that the duration of some of the soft-based species of *Xyris* such as *X. jupicai*

[1]Expenses incurred in the field work contributing to this research were met in part by a grant from the National Science Foundation (G-2010) to Dr. R. K. Godfrey.

and *X. curtissii* (the latter here treated as *X. serotina* var. *curtissii*) is not certain; such plants may be annual in the northern part of their respective ranges, biennial or perennial to the south. In hard, or bulbous-based species such as *X. flexuosa, X. platylepis, X. ambigua, X. baldwiniana, X. elliottii,* and *X. scabrifolia,* there is an obvious perennation by means of lateral offshoots. In evidently annual species such as *X. flabelliformis* and *X. brevifolia,* there may be two or even three flowering generations per season in a given locality if moisture conditions are favorable. However, these annuals during the course of the season may also spread by short lateral offshoots to form sizeable tufts. The first species to bloom in the spring in Florida are *X. flabelliformis, X. brevifolia, X. elliottii* and *X. baldwiniana* (some southern peninsular Florida individuals reach anthesis by late February or March): by late spring or early summer all of the other species will have commenced to bloom, reaching their height by late summer or early fall.

HABIT. Florida species of *Xyris* exhibit three types of growth habit. The commonest type is that exhibited by *X. jupicai, X. iridifolia, X. serotina, X. smalliana, X. fimbriata, X. difformis,* and *X. flabelliformis.* These are all soft based annuals or short-lived perennials with reduced, diffuse root systems. A second type is that of *X. platylepis, X. ambigua,* and *X. flexuosa,* in which the plant is an evidently longer-lived perennial with a bulbous or fibrous-thickened base. A third type is exemplified by *X. elliottii, X. brevifolia, X. baldwiniana,* and *X. drummondii,* where the plant base is hard but not bulbous or thickened. All of the species have equitant, distichous foliage. In *X. flabelliformis* and *X. ambigua* this feature is particularly evident, the curvate leaves spreading out fan-like. All *Xyris* species of Florida are scapose, with their floral organs compacted into a cone-like tough-bracted, spike. However, in *X. flabelliformis* and *X. brevifolia,* the internodes of the inflorescence are so shortened as to give a head-like appearance.

LEAVES. Features of the leaf, while of some assistance in identification, may be misleading. Shape, size, apex, and margin of leaf are too variable within the individual species to be used independently. However, the nature of the in-

Figs. 1 - 14. Bracts, lateral sepals, seeds and spikes of *Xyris*. Fig. 1. *Xyris flexuosa*; fig. 2. *X. fimbriata*; fig. 3. *X. iridifolia*; fig. 4. *X. ambigua*; fig. 5. *X. scabrifolia*; fig. 6. *X. platylepis*; fig. 7. *X. flabelliformis*; fig. 8. *X. drummondii*; fig. 9. *X. brevifolia*; fig. 10. *X. baldwiniana*; fig. 11. *X. elliottii*; fig. 12. *X. serotina*; fig. 13. *X. jupicai*; fig. 14. *X. smalliana*.

dument of the leaf surface is significant. The leaf surfaces of some species are completely smooth while those of others show degrees of scabrousness or papillosity. All the species of *Xyris* have leaves which are dilated at the equitant base. The extent, hardness, and coloration of the dilated portion are diagnostic.

SCAPE. The leaves in all species are exceeded by the elongate scape. Depending upon the species, the scape may be ribbed, prominently two-ridged, or smooth; it may be terete, blocky, or flattened in the cross-section. Scabrousness of the scape surfaces, particularly of the ridges, or ribs, is a distinctive feature, and the nature and relative length of the sheath are important characteristics.

BRACTS. The bracts of the Xyris spike are spirally arranged, rigid, and characterized by greenish, gray-green, or maroon subapical areas on the dorsal surfaces. The latter are generally referred to as "dorsal areas". The apices of the bracts may be entire, emarginate, or ragged, and may serve as useful taxonomic features.

FLOWERS. Xyris flowers are three-merous. One of the three sepals disarticulates with the corolla and/or fruit; the other two are boat-like structures which clasp the capsule laterally. These lateral sepals have keels, the nature of whose extent and margin (ciliate, lacerate, fimbriate) are critical taxonomic criteria. The spreading, three-parted corolla, the bifid staminodes, and the rest of the androecium are fairly consistent throughout the species; therefore such features are seldom used diagnostically. The filiform, trifid style disarticulates soon after anthesis; the compressed obovoid or ovoid, three-placental capsule has a papery pericarp which ruptures irregularly to disclose a large quantity of parietally arranged seeds. Relative size, color, and ribbing of the seed may be of importance in distinguishing the taxa.

DESCRIPTION OF XYRIS SECTION XYRIS

Perennial or annual, tufted or solitary, scapose herbs from a short soft, fibrous or bulbous rootstock, the roots fibrous. Leaves basal, tufted, equitant, distichous, the linear or terete-filiform blades abruptly or gradually dilated at the base. Inflorescence a contracted, compact bracteate, cone-like spike (or, more nearly, a head-like spike). Flowers perfect, zygomorphic, axillary to the leathery, imbricate bracts. Calyx of three members; the lower two boat-like, chaffy, keeled, and persis-

tent; the upper membranaceous and covering the young corolla. Corolla gamopetalous, salverform, with three equal, yellow or white lobes. Stamens three, opposite the corolla lobes, adnate to the tube; staminodes three, alternating with the corolla lobes, bifid. Ovary superior, 3-parietal; style 3-branched; stigma linear. Fruit capsular, oblong-compressed, the thin pericarp with an irregular dehiscence. Seeds small, striate, ovoid, ellipsoidal or fusiform, usually apiculate and/or caudate.

KEY TO XYRIS IN FLORIDA

1. Plant bases bulbous, fibrous-thickened, or thickened by chaffy aggregations of persistent leaf bases.
   2. The plant bases bulbous or fibrous-thickened; plants solitary or in small tufts.
      3. Plants tuberculate-roughened on all scape and leaf surfaces.... ..... 1. *X. scabrifolia*, fig. 5.
      4. The plants perennating by lateral or terminal shoots; leaves spreading fanlike, scarcely twisted; dead leaf bases persistent, fibrous, shreddy; keel of lateral sepals ciliate. (Farinose-seeded, broad-scaped individuals may be found here, these identified as *X. ambigua* x *X. iridifolia*)..... .....2. *X. ambigua*, figs. 4, 22.
   4. The plants perennating by lateral shoots, the bases bulbous; leaves ascending, twisted; dead leaf bases scale-like or chaffy.
      5. Base of plant deeply set in substrate, comprised of hard, castaneous, scale-like, leaf bases..... .....3. *X. flexuosa*, figs. 1, 20.
      5. Base of plant shallowly set in substrate, comprised of fleshy, pinkish, ivory, or brown leaf bases; outermost leaves scale-like.....4. *X. platylepis*, figs. 6, 21.
2. The plant bases somewhat thickened, of hard, leathery, brown, long-persistent leaf bases; plants forming large tufts.
   6. Leaf linear, but flat, with prominent pale, papillate or low-tuberculate, cartilaginous margin; scape two-or-more-ridged above, so flattened as to appear narrowly elliptic in the cross section; scapes usually narrower than the leaves; spikes seldom less than 6 mm long (but no longer than 1.5 cm), the older bracts conspicuously lacerate..... .....12. *X. elliottii*, figs. 11, 26.
   6. Leaf linear filiform, terete, blocky or somewhat flattened in fresh condition, without prominent, pale, papillate margins; scapes usually rounded or broadly elliptic in cross section above; scape ridges, if present above, low; scapes usually broader than leaves; spikes small, seldom longer than 6 mm.... .....11. *X. baldwiniana*, figs. 10, 23.
1. Plant bases neither bulbous, or fibrous-thickened, or chaffy with persistent leathery leaf bases; leaf bases, with exception of no. 7, usually soft and not persistent.

7. Leaves equalled or exceeded by the sheaths of the scape; dwarf, filiform-scaped species.
   8. The leaves broadly linear, usually over 1 mm broad, flabellately spreading; keel of lateral sepals ciliate; bracts usually entire.
      9. Sheaths of the scape about equalling the length of most of the leaves; leaves 3-6 cm. long; smooth; low perennials..... .....5. *X. drummondii*, figs. 8, 25.
      9. Sheaths of the scape exceeding the leaves; leaves usually less than 3 cm long, papillose or minutely tuberculate; dwarf annuals, often of a pale maroon coloration..... .....6. *X. flabelliformis*, figs. 7, 18.
   8. The leaves narrowly linear, usually 1 mm broad or less, ascending; bracts usually ragged, often purplish, at the apex; dwarf annuals.....7. *X. brevifolia*, figs. 9, 24
7. Leaves exceeding the sheaths of the scapes; taller, linear-scaped species.
   9. Plant base bright pink or purplish.
      10. Tips of lacerate sepals slightly to conspicuously exserted; tall plants of wet to inundated soils..... .....14. *X. smalliana*, fig. 14.
      10. Tips of lacerate sepals not exserted.
         11. Seeds farinose.
            12. Scape seldom taller than 60 cm; more than two-ridged or angled above, the ridges scabrous; mature spikes ovoid, never more than 1.5 cm long .....9. *X. serotina* var. *serotina*, figs. 12, 17.
            12. Scape seldom less than 60 cm long, conspicuously flattened and two ridged above, the margins broad and smooth; mature spikes oblong or narrowly ovoid, rarely less than 1.5 cm long. .....8. *X. iridifolia*, figs. 3, 15.
         11. Seeds not farinose.
            13. Scapes more than 2-ridged above, all the ridges scabrous, and broadly elliptic in the cross section above.....10. *X. serotina* var. *curtissi*.
            13. Scapes seldom more than 2-ridged above, definitely and broadly flattened beneath the spike, therefore narrowly elliptical in the cross section..... .....16. *X. difformis*.
   9. Plant base tan, greenish, or yellowish-green.
      14. Lateral sepals exserted; spikes seldom less than 1.5 cm long.
         15. The upper keel of the lateral sepals fimbriate; ridges of the scape rough to the touch..... .....13. *X. fimbriata*, figs. 2, 16.
         15. The upper keel of the lateral sepals lacerate; ridges of the scape smooth to the touch (under magnification may be distantly low-tuberculate).....

14. Lateral sepals not exserted; spikes seldom more than 1.5 cm long; scape ridges usually papillose, minutely scabrid, or tuberculate.
    16. Leaves broadened at or above the middle, often flabellately arranged; scape conspicuously broadened and flattened above.....16. *X. difformis.*
    16. Leaves linear, ascending; scape not conspicuously broadened and flattened above.....15. *X. jupicai*, figs. 13, 19.

TREATMENT OF THE SPECIES

1. **Xyris scabrifolia** Harper, Bull. Torrey Bot. Club **30**: 325. 1903. Fig. 5. Solitary, bulbous based, perennials, superficially resembling *X. platylepis*. Leaf linear, 30-40 cm long, 5-10 mm broad, twisted, *striate-scabrid throughout*, acute or blunt, the equitant portion about 1/8 the total leaf length, abruptly flaring at the pale brown, ultimately fibrous, base. Scape 60-90 cm long, twisted and sometimes flexuous, terete and multicarinate below, *2 to 4 carinate above, striate-tuberculate between the scabrid ridges*. Sheath of the scape 8-12 cm long, with a short blade. Spike 11-20 mm long, obovoid or ellipsoid, of many tightly imbricate bracts. Fertile bracts 6-8 mm long, obovate, entire, or somewhat erose with age, dull reddish-brown or brown with a broadly elliptic or rhombic gray-green dorsal area. Lateral sepals inserted, about the length of the subtending bract, brown, the ascending-lacerate keel broadening toward the summit. Seeds fusiform-caudate, 0.6-0.9 mm long, pale and transparent.

Moist to wet sandy peats of acid sphagnous bogs, northwest Florida and central Georgia.

Type. GEORGIA. MERIWETHER CO.: open bog near Woodbury, *Harper 1254*.

Representative specimens. FLORIDA. ESCAMBIA CO.: hillside bog along Bayou San Marcus Creek, w. of Pensacola, *Kral & Godfrey 6000*. LIBERTY CO.: boggy seepage slopes along small tributary of Taluga River 1.7 mi. w. of Hosford, *Thorne & Davids 16453*. WASHINGTON CO.: cypress-gum pond, 3.5 mi. e. of Caryville, *Kral & Godfrey 6000a*.

2. **Xyris ambigua** Beyr., Kunth, Enum. Pl. **4**: 13. 1843. Figs. 4, 22. ?*Xyris stricta* Chapm., Fl. S. U. S. 500. 1860. Solitary or tufted, hard and fibrous-based perennials. Leaf *spreading, broadly linear*, 15-40 cm long, 3-15 mm broad, curvate, flat or slightly twisted, minutely tuberculate along the margins, elsewhere smooth; tips blunt to narrowly acute; bases *conspicuously and abruptly dilated, fibrous, long persistent*, the equitant portion 1/4-1/2 the total leaf length, brownish. Scape 70-100 cm long twisted, terete and multicarinate below, usually somewhat flattened and bicarinate above, the ridges minutely tuberculate; sheaths of the scape 10-20 cm long, the short ascending blade comprising less than 1/4 the total sheath length. Spike 1.5-3.0 cm long, narrowly elliptical to oblanceolate in outline, blunt to acute, of many, closely imbricate bracts. Fertile bracts 8-10 mm long, broadly obovate

to orbicular, entire to somewhat erose at the apex, reddish-brown to pale brown with a roughly rectangular, olive to dark brown dorsal area. Lateral sepals inserted, tan to reddish, about 1 cm long with a broad, *ciliate* keel. Seeds ovoid to ellipsoidal, 0.4-0.5 mm long, many ribbed.

Moist sands or sandy-peats of bog margins, savannas, flatwoods pond margins, lakeshores and roadside ditches, North Carolina south to Florida, west in the Coastal Plain to Texas.

Type Locality. According to Malme (1937) the type is from "margins of swamps, Georgia". The present author has not examined it.

Florida material examined, by county. Baker, Bay, Brevard, Calhoun, Charlotte, Citrus, Duval, Escambia, Flagler, Franklin, Gulf, Hernando, Hillsboro, Indian River, Jefferson, Lake, Lee, Leon, Levy, Liberty, Okaloosa, Orange, Palm Beach, Pasco, Pinellas, Polk, Santa Rosa, Sarasota, Sumter, Volusia, Wakulla, Washington.

Although *Xyris ambigua* does occur in bogs, usually it does not occur in areas of standing water; rather, it is a plant of the upper margins of boggy habitats. In the herbarium at Florida State University, there is an unusual specimen, superficially resembling *X. ambigua,* that was collected from the shallow water of a cypress pond (Franklin Co., Florida; in shallow water, cypress-gum swamp 7 mi. n. of East Point, *Godfrey 55724*). Because of the atypical habitat the collection was examined in detail. It was discovered that this population has farinose seeds and much broader and flatter upper scapes than are common to *X. ambigua.* I was interested to note the similarity between this Godfrey collection and the type and isotype specimens of *Xyris stricta* Chapm. (*Florida.* Franklin Co.: "Appalachicola, Chapman") kindly sent from the New York Botanical Garden and from the Gray Herbarium. Chapman (1860) described a more aquatic situation for his *X. stricta* than is usual for *X. ambigua.* The latter is a plant of moist, certainly not wet, habitats; thus there is also agreement, habitatwise, between the Chapman and the Godfrey collections.

Only one *Xyris* of northwest Florida *(X. iridifolia)* has a tall habit combined with a conspicuously flattened upper scape and farinose seeds together with an aquatic habitat. That these features appear in *X. stricta* Chapm. together with a predominance of characteristics of *X. ambigua* leads one to suspect the former to be a hybrid. I have annotated all such specimens with the formula "*Xyris ambigua* Beyr. x

Xyris iridifolia Chapm." with the hope of studying the living plants some time during the summer or fall of 1960.

3. **Xyris flexuosa** Muhl. ex. Ell., Sk. Bot. S. C. & Ga. 1: 51. 1816. Figs. 1, 20. *Xyris torta* Kunth, Enum. Pl. 4: 14. 1843, not *X. torta* Smith, 1818. *Xyris arenicola* Small, Fl. SE. U.S. 234. 1903, not *X. arenicola* Miq. 1844. Solitary or tufted, bulbous-based perennials, the *castaneous bases deeply set in the substrate.* Leaf linear, 20-50 cm long, 2-5 mm broad, ascending, twisted and flexuous, fleshy, minutely tuberculate along the margins, otherwise smooth and lustrous; tip blunt to acute; *base abruptly dilated, dark brown, shiny, long persistent as shreddy scale;* equitant portion 1/4-1/3 the total leaf length, brownish. Scape 50-110 cm long, twisted, flexuous, smooth to minutely ridged and terete below, oval in cross section and smooth to 1-ridged above, the ridges, if present, minutely tuberculate; sheath of the scape 10-15 (-17) cm long, close, the blade comprising 1/9 or less of the total sheath length. Spike 1.5 (-1.3) -3.0 cm long, elliptic to narrowly oblanceolate in outline, blunt to broadly acute, of few to many closely imbricate bracts. Fertile bracts 0.5-1.0 (-1.3) cm long, oblong to obovate, entire or emarginate, becoming erose, reddish-brown to tan with an elliptic or rectangular gray-green to brown dorsal area. Lateral sepals *slightly to conspicuously exserted,* tan to reddish-brown with a broad, finely dissected *keel* which is fimbriate at the apex. Seeds fusiform, about 1 mm long, caudate, many ribbed.

Moist sands of pine flatwoods or savannas; well drained sands or lower reaches of scrub oak-pine barrens, New Jersey to Florida, west to Texas and Arkansas.

Type. According to Dr. Harper (1905), who was the first to clearly interpret this species, the name *X. flexuosa* first appears in the first edition of Muhlenberg's Catalogue (1813), but the first description of it does not appear until 1816 in Elliott's Botany of South Carolina and Georgia. The description of Elliott defines the species adequately.

Florida material examined, by county. Alachua, Brevard, Calhoun, Charlotte, Citrus, Collier, Columbia, Escambia, Flagler, Franklin, Gulf, Hernando, Highlands, Holmes, Indian River, Jefferson, Leon, Lake Manatee, Nassau, Okaloosa, Orange, Pasco, Pinellas, Putnam, Santa Rosa, Seminole, Sumter, Volusia, Wakulla, Washington.

Of all the Florida *Xyris*, *X. flexuosa* is the only species found on relatively dry sites. It may occur in savannas, often in close proximity to palmetto clumps, but generally where there are deep sands and little standing water. Doubtless the deeply set, thickened plant base so unique to this species is associated with its occurrence in the drier habitats.

There are two forms of *X. flexuosa.* One, by far the most common over the total range of the species, is yellow-flowered. The other, of less frequent occurrence, is white-flowered

and had been designated as a species by Small *(X. pallescens* Small, Man. SE. Flora, 1933). This form becomes increasingly abundant the farther south one goes in Florida until, in the moist sands of the south-central peninsular flatwoods, it is encountered as frequently as the yellow flowered form.

4. **Xyris platylepis** Chapm., Fl. S. US. 501. 1860. Figs. 6, 21. Solitary (or in clumps of a few plants), *bulbous based perennial,* the *base superficial on the substrate.* Leaves, except for the outermost scale-like ones, linear, 20-40 (50) cm long, 5-10 mm broad, twisted, ascending, flexuous, fleshy, minutely tuberculate along the margin, otherwise smooth; tip blunt to acute; equitant portion 1/3-1/2 the total leaf length, its *base abruptly dilated, ivory white or pink. Outermost leaves scale-like,* quickly aging to a dull brown color, persisting on the base but a short time after anthesis. Scape 50-120 cm long, twisted, sometimes flexuous, many ridged and terete below, 2, 3 or 4-ridged and slightly flattened above, the ridges scabrous. Spike broadly elliptic to ovoid or oblong, 1.5-3.0 (-4.0) cm long, of numerous, closely imbricate bracts. Fertile bracts obovate, 5-7 mm long, entire, with an oblong to deltoid dark green dorsal area. Lateral sepals inserted, tan, with the *keel broadly and finely lacerate-winged above.* Seeds ellipsoidal, about 0.5 mm long.

Moist to wet sands or sandy peats of pineland pond margins, savannas, bogs and marshes, Florida to Virginia, west in the Coastal Plain to Louisiana.

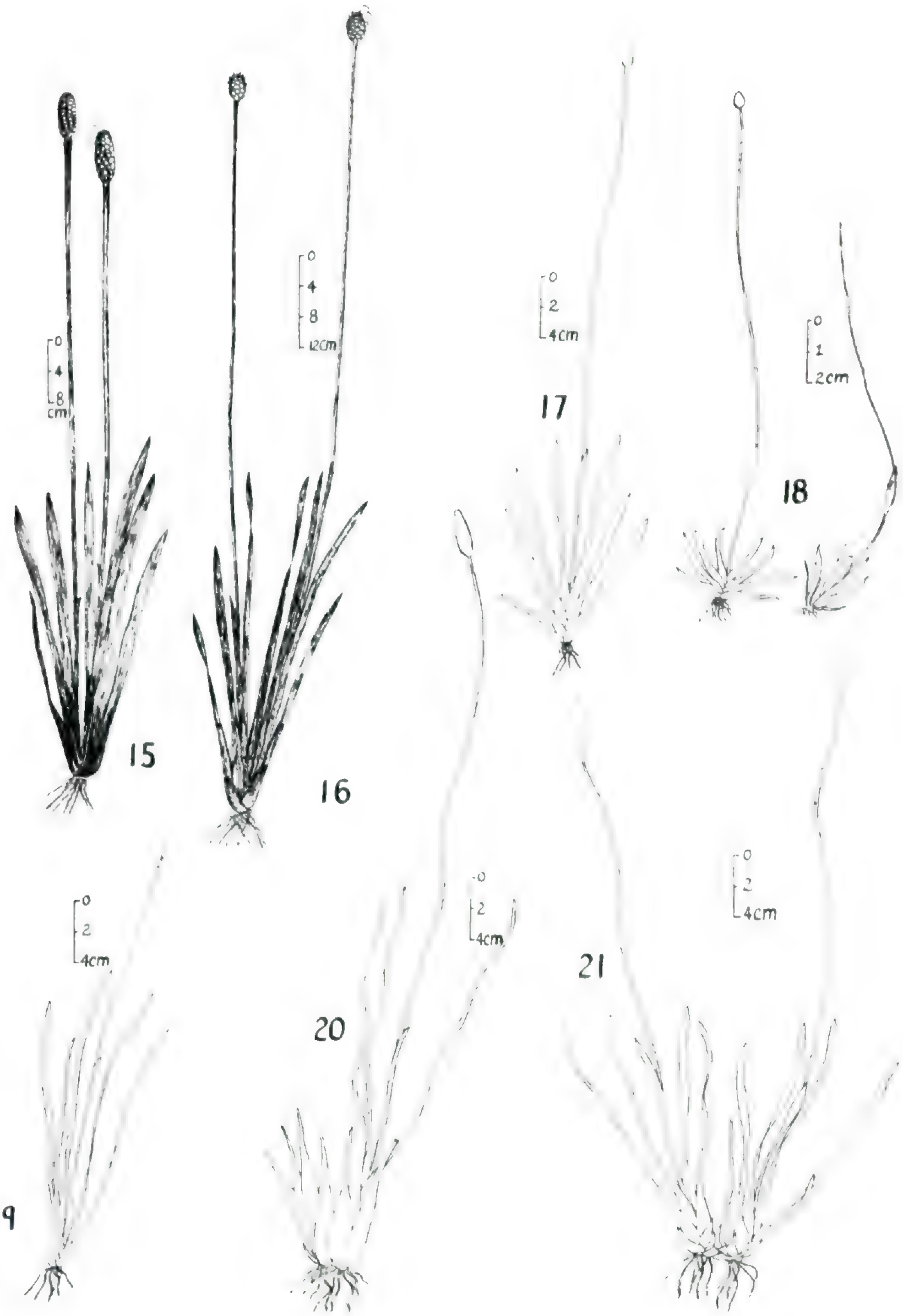
Type. FLORIDA, FRANKLIN CO.: Apalachicola, *Chapman.*

Florida material examined, by county. Alachua, Brevard, Citrus, Columbia, Duval, Franklin, Gadsden, Hamilton, Hardee, Hernando, Highlands, Hillsboro, Indian River, Jefferson, Leon, Levy, Liberty, Madison, Manatee, Marion, Orange, Pasco, Polk, Putnam, St. Lucie, Seminole.

Xyris platylepis is best distinguished by its fleshy, bulbous base which is made up of the abruptly widened, succulent, leaf bases. The margins of the lower portions of the leaves are transparent, while from the inner surfaces a gelatinous substance is exuded which makes the plant slimy to the touch. Also distinctive are the scale-like, appreciably shorter, outermost leaves.

Xyris platylepis is not truly aquatic, although it may occasionally be found in the shallow water of temporary pools. Such individuals are less bulbous-based and, although the bases usually keep their ivory white or pinkish coloration and scale-like outer leaves, the plants are somewhat reminiscent of taller specimens of *X. difformis.*

Xyris platylepis shows the same petal color variation as



Figs. 15 - 21. Outline sketches of some *Xyris* species. Fig. 15. *X. iridifolia*; fig. 16. *X. fimbriata;* fig. 17. *X. serotina;* fig. 18. *X. flabelliformis;* fig. 19. *X. jupicai* (leaves and plant base); fig. 20. *X. flexuosa*; fig. 21. *X. platylepis.*

does *X. flexuosa,* at least in southern peninsular Florida where white-flowered plants are not infrequent. When such forms are in evidence, not only is the entire population white flowered, but also neighboring populations of *X. flexuosa.*

5. **Xyris drummondii** Malme, Ark. Bot. 25A: 14. 1933. Fig. 8. Solitary or tufted, soft-based, biennial (perennial?). Leaf broadly linear, 3-6 cm long, 1.5-3 mm broad, smooth or slightly papillose toward the base; tip acute to acuminate; equitant portion conspicuously dilated, green, with an *abruptly castaneous base.* Scape 22-30 cm long, slightly twisted, ribless and oval to terete below, 1-2 ribbed and somewhat flattened above, the ribs smooth or papillose; *scape sheath about the length of the leaves,* the ascending blade about 1/3 the total length of the sheath. Spikes 7-10 mm long, narrowly ovoid, of a few loosely imbricate bracts. Fertile *bracts* 3-5 mm long, ovate to broadly elliptic, entire, carinate, light to dark brown with a paler, inconspicuous elliptic dorsal area. Lateral sepals inserted, falcate, about the length of the bracts, *ciliate-keeled.* Seeds about 0.5 mm long, ovoid, many ribbed, the ribs inconspicuous.

Sandy-peats of roadside ditches or hillside bogs, Coastal Plain, West Florida, Alabama and Mississippi.

Type. Specimens collected by the author, or by Dr. Godfrey, conform so closely to the description of the species by Malme (1937) and differ so significantly from either *X. brevifolia* or *X. flabelliformis,* that it seems reasonably certain that they should be included as new records for *X. drummondii.* Malme (1. c.) states only "Alabama" as the type locality, the collection presumably one by Drummond.

Xyris drummondii is but one of three diminutive species of *Xyris* now known to occur in Florida. It is readily separable from either *X. flabelliformis* or *X. brevifolia* by its perennial nature, its scape sheaths which are equal to the leaves in length, and by the conspicuous reddish-brown patches at the leaf bases. Hitherto known only from the type locality in Alabama, it is here recorded for west Florida and southeastern Mississippi: FLORIDA. ESCAMBIA CO.: hillside bog along Bayou San Marcus Creek, w. of Pensacola, *Kral & Godfrey 5999.* LIBERTY CO.: wet pine flatwoods, 8 mi. s. Hosford, *Godfrey 55683.* MISSISSIPPI. GEORGE CO.: 7 mi. n. w Wilmer on sandy peaty clay of hillside bog, *Kral 7135.*

6. **Xyris flabelliformis** Chapm., Fl. S. US. 499. 1860. Figs. 7, 18. Solitary or tufted, soft-based annuals. *Leaf* broadly linear, spreading, 1-3 cm long, 1-3 mm broad, *curvate, flabellately arranged,* smooth, or striate-papillose with a papillose or low-tuberculate margin, maroon or greenish brown; tip acute; *equitant portion conspicuously inflated and hyaline-margined toward the base* and comprising 50-60 percent of the total leaf length. Scape 10-30 cm long, filiform, twisted, terete or with one or two low ridges above, smooth; scape sheath exceeding all or most of the leaves, the ascending blade up to 1/3 the total length

of the sheath. *Spike* 0.5-1.0 cm long, ovoid, ellipsoid or globose, *of a few, loosely imbricate bracts. Fertile bracts* 3-5 cm long, ovate to elliptic or obovate, *entire* (occasionally somewhat lacerate with age), slightly carinate, greenish-brown or tan with a pale green, papillose dorsal area. *Lateral sepals* inserted, *falcate, the keel finely but evenly ciliate.* Seeds about 0.5 mm long, ellipsoid, striate.

Exposed wet sands of savanna-bogs, pineland pool margins and roadside ditches, northeastern Florida north and west along the Gulf to Mississippi.

Type. FLORIDA. FRANKLIN CO.: "Apalachicola, *Chapman*".

Florida material examined, by county. Alachua, Baker, Citrus, Dade, Duval, Franklin, Flagler, Gulf, Hamilton, Hernando, Jefferson, Madison, Lee, Leon, Levy, Putnam, Suwannee, Wakulla.

Xyris flabelliformis, together with *X. brevifolia*, is one of the first of the genus to flower in the spring and may be an aspect dominant on any area of wet, disturbed sands within its range. While it has often been mistaken for *X. brevifolia* it may be distinguished from the latter by its softer base, its entire bracts, and by its relatively shorter, broader leaves which are curvate, flabellately arranged and usually of a maroon tint. While the keel of the lateral sepals of *X. flabelliformis* is finely ciliate, that of most specimens of *X. brevifolia* ranges from entire to papillose or minutely tuberculate.

7. **Xyris brevifolia** Michx., Fl. Bor. Am. 1: 23, 1803. Figs. 9, 24. Solitary or tufted, *hard-based annual.* Leaves narrowly linear, ascending, 2-5 (-7) cm long, 0.5-2.0 mm broad, flat or slightly twisted, smooth or with a low-tuberculate margin; tip acute; equitant portion abruptly inflated toward the brown, hard base. Scape 10-40 cm long, filiform, terete, or with one or two low ridges above, smooth; sheath of the scape exceeding all or most of the leaves, the ascending blade up to 1/4 the total sheath length. Spikes about 0.5 cm long, ovoid or globose, of a few loosely imbricate bracts. *Fertile bracts* 3-5 mm long, ovate to narrowly obovate, *lacerate,* greenish-brown save for the *maroon, lacerated apical portion* and the dark green or dark reddish-green elliptic dorsal area. Lateral *sepals* inserted, curbed or striate, the *keel smooth or finely tuberculate* (very rarely ciliate). Seeds about 0.5 mm long, ellipsoid, striate.

Exposed wet sands of pine flatwoods, pineland pond margins, grass-sedge bogs, and roadside ditches, North Carolina to Florida and west along the Coastal Plain to Alabama.

Type. Wet meadows, Coastal Georgia, Michaux. Not seen.

In north Florida I have often observed this species intermixed with *X. flabelliformis;* it is best distinguished from the latter by its longer, proportionately narrower. leaves. its

lacerate (sometimes squarrose) bracts, its tough leaf bases and its tendency to form clumps of dozens of individuals. In fact, *X. brevifolia* exhibits many features of the perennial, clump-forming, *X. elliottii* which has hard-based, linear leaves and lacerate bracts. As one travels south through the flatwoods of peninsular Florida, enormous mixed populations of both species are encountered and the similarity between the two becomes the more striking. Yet, as one travels north and west in Florida, into the optimum range of *X. flabelliformis*, populations of *X. brevifolia* are frequently broader leaved, softer-based, and show a closer affinity to *X. flabelliformis*. Obviously, this is a highly plastic species; detailed population studies may show at least two distinct races.

Florida material examined, by county. Alachua, Baker, Bradford, Brevard, Charlotte, Citrus, Columbia, DeSoto, Duval, Franklin, Hamilton, Hernando, Highlands, Hillsboro, Indian River, Jefferson, Lee, Leon, Levy, Liberty, Manatee, Marion, Orange, Pinellas, Putnam, Sarasota, St. Johns, St. Lucie, Sumter, Taylor, Union, Volusia, Wakulla.

8. **Xyris iridifolia** Chapm., Fl. S. US. 501. 1860. Figs. 3, 15. Solitary or tufted, soft-pink or purplish-based perennials (biennials?). Leaf linear, iridiform, 40-70 cm long, 10-20 mm broad, flat or slightly twisted, smooth; tip broadly acute to blunt; *base* slightly dilated, the *equitant* portion about 1/5 the total leaf length, *pink or pale maroon* with a broad hyaline margin. *Scape* 60-90 cm tall, slightly twisted, terete and 2 ridged below, *conspicuously broadened and flattened above, the edges smooth* (at least under 10x magnification); *sheathes of the scapes pink or maroon-based*, about 20 cm long, with the ascending blade comprising over 1/2 the total sheath length. Spike 2.0-3.5 cm long, oblong, to broadly oblanceolate in outline, of many, closely imbricate bracts. Fertile *bracts* 6-7 mm long, broadly obovate to orbicular, entire, *dark purplish or reddish-brown, shining except for the paler green or gray-green oval or roughly triangular dorsal area. Lateral sepals* inserted, *castaneous*, 5-7 mm long, with a broad, jagged to finely dissected keel. *Seeds* about 0.8-1.0 mm long, narrowly fusiform many-ribbed, *farinose.*

Wet sands or muck of stream banks, marshes, or pineland pond margins, sometimes with the bases submerged, North Carolina to north Florida, west in the Coastal Plain to Texas.

Type. FLORIDA. FRANKLIN CO.: Apalachicola, *Chapman.*

Florida material examined, by county. Calhoun, Escambia, Franklin, Liberty, Okaloosa, Washington.

Xyris iridifolia, like *X. smalliana* and *X. fimbriata*, is a robust plant of marshy habitats, but is distinguished from

both of these species by the rich purplish or pinkish coloration of its leaf and scape bases, its relatively broad leaf outline (1 - 2 or 2.5 cm), its proportionately broader scape, and its thick, oblong, maroon-tinted spikes. These features, in addition to the farinose seed character, make *X. iridifolia* easily distinguishable. Putative hybrids of *X. iridifolia* with *X. ambigua (Godfrey 55724)* and with *X. fimbriata (Kral & Godfrey 5954)* have been collected in west Florida. Plants of the latter series of specimens have the farinose seeds and maroon pigmentation of *X. iridifolia*, but the general aspect and exserted sepals of *X. fimbriata*.

9. **Xyris serotina** Chapm., Fl. S. US. 500. 1860. Figs. 12, 17. Solitary or tufted, *soft-purplish-based*, annuals or perennials. Leaf linear, 5.5-25.0 cm long, 2-7 (-9) mm broad, flat or slightly twisted, the *margin tuberculate-scabrid, the surfaces papillose to striate-tuberculate;* tip broadly acute to acuminate; equitant portion but slightly dilated, 1/2-1/4 the total leaf length, *pink, greenish-maroon, or purplish with a pale, papillose, hyaline margin.* Scape 40-60 (-70) cm tall, slightly twisted, multicostate and terete below, 2-5-ridged and roughly oval in cross section above, the *ridges tuberculate-scabrid*, the intercarinal areas smooth or papillose; scape sheath 3-7 cm long, purplish, pinkish or brownish based, close, the narrow, ascending sheath blade about 1/3 the length of the sheath. Spike 1-1.5 cm long, ovoid-acute or ovoid apiculate, of many closely imbricate bracts. Fertile bracts 4-6 mm long, broadly obovate to orbicular, entire, reddish-brown to brown save for the dull green to contrasting brown, papillose, oval or obovate dorsal area. Lateral sepals inserted or exserted, castaneous, about 5 mm long, with a broad, jagged to finely cut keel. *Seeds* broadly ellipsoid, about 0.5 mm long, many-ribbed, *farinose*.

Moist exposed sands or peats of pine flatwoods, roadsides and savannas, Florida west to Mississippi.

Type. FLORIDA. FRANKLIN CO.: Apalachicola, *Chapman*.

10. **Xyris serotina** Chapm. var. **curtissii** (Malme), comb. nov., based on *Xyris curtissii* Malme, Ark. Bot. **13**: 24. 1913.

As the species, but with leaves tending to be elliptic linear; seeds not farinose but a deep, clear yellow or amber.

In the same habitats as the species, southeastern Virginia south in the Coastal Plain to Florida, west to Mississippi.

Type. FLORIDA. DUVAL CO.: near Jacksonville, *Curtiss 4316*.

Upon comparing the description of Malme (1937) for *X. serotina* and *X. curtissii*, and upon consultation of the type specimens of both, I was able to find but one significant qualitative difference — that of farinose seed for the former, clear seed for the latter. Examination of a series of specimens of

both shows that there are no consistent differences of height, spike size or shape, leaf shape, indument or habit. If their ranges were co-incidental, these two entities might well be considered forms of a polymorphic species, yet the range of *X. curtissii* Malme extends north to Virginia while that of *X. serotina* Chapm. is, so far as is now known, confined to peninsular Florida and the Gulf Coastal Plain. It seems better therefore, to treat these two as geographical varieties.

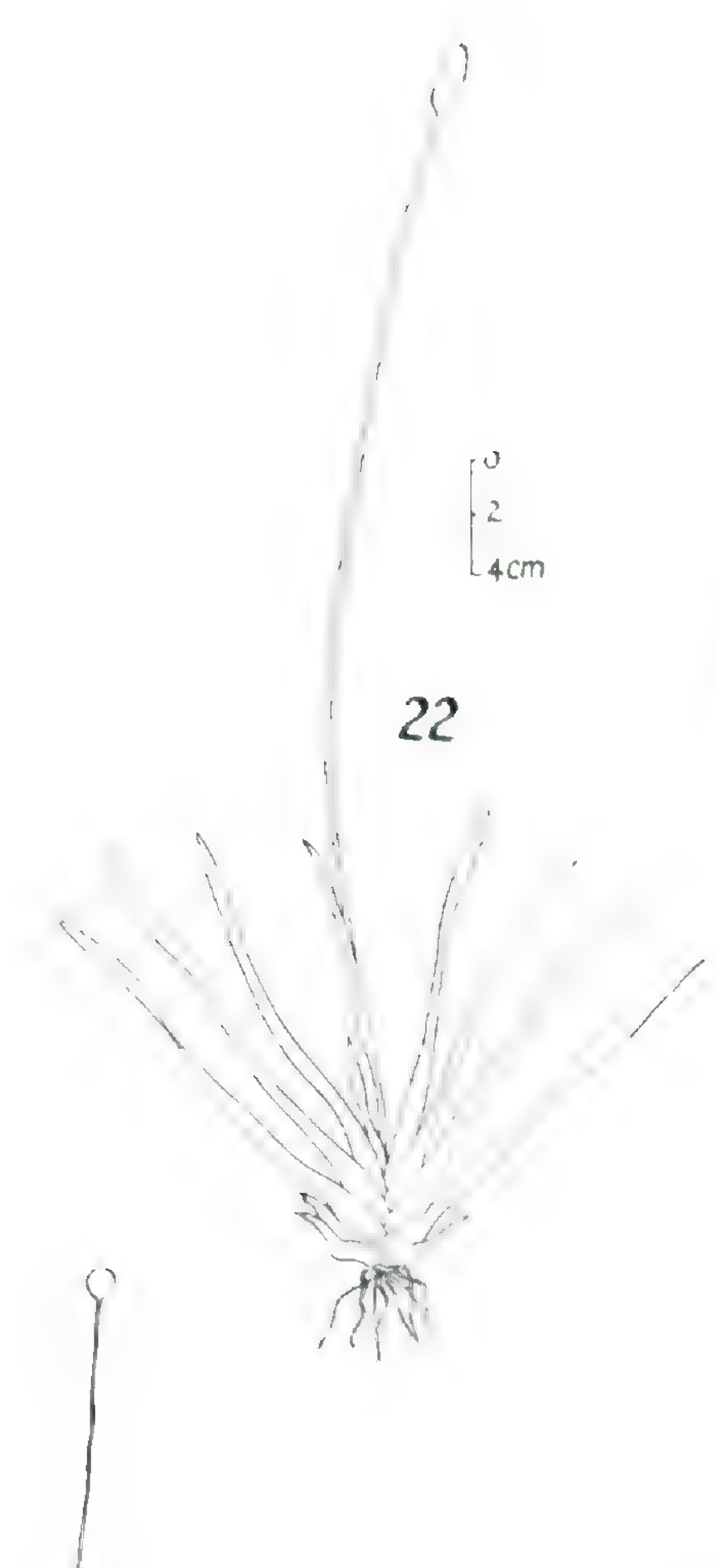
11. **Xyris baldwiniana** Schultes, in R. & S. Syst. Veg. Mant. 1: 351. 1822. Figs. 10, 23. Tufted, hard-brownish-based perennials. *Leaf filiform-terete* (or blocky to elliptic in the cross section of dried material), 10-30 cm long, straight or slightly twisted, smooth; equitant portion 1/8-1/6 the total leaf length, more or less abruptly dilated and brown to castaneous toward the base. Scape 20-40 (-50) cm long, *usually broader than the leaf*, terete below, one-ridged and *tending to be terete above*; sheath of the scape 7-15 cm long, brownish based, the narrow, ascending blade usually less than 1/5 the total length of the sheath. Spike 4-6 (-7) mm long, ellipsoid, of a few *tightly imbricate bracts*. Fertile bracts ovate or obovate, 4-5 mm long, lacerate at the apex, dull brownish with an elliptic, dull green, dorsal area. Lateral sepals inserted, about the length of the bracts, the wings ragged above. Seeds ellipsoid, about 0.5 mm long, many ribbed.

Moist sands or sandy peats of pine flatwoods, hillside bogs, roadside ditches, and savannas, North Carolina south to Florida and west in the Coastal Plain to Texas.

Type. According to Malme (1937) the type locality is "wet pine-barrens near St. Mary's, Georgia". The writer has not seen the type, but has examined the type of *Xyris tenuifolia* Chapman which, from the description of Malme (who treats it as *Xyris baldwiniana* var *tenuifolia* (Chapm.)), is only a flatter-leaved version of *X. baldwiniana.*

Florida material examined, by county. Bay, Calhoun, Duval Escambia, Franklin, Gadsden, Gulf, Highlands, Levy, Liberty, Marion, Nassau, Putnam, Wakulla, Walton.

Xyris baldwiniana is most often confused with *X. elliottii* Chapm., a tuft-former with a similar habit, but it differs from the latter in its narrower leaves, its more or less terete upper scape, and its smaller spikes. In addition, the sometimes quite prominent pale cartilaginous margin of the flatter leaves of *X. elliottii* is lacking in *X. baldwiniana*. A difference that is particularly noticeable in the field is the stout, evidently terete appearance of the scapes of *X. baldwiniana*; the scapes of *X. elliottii* appear much more slender



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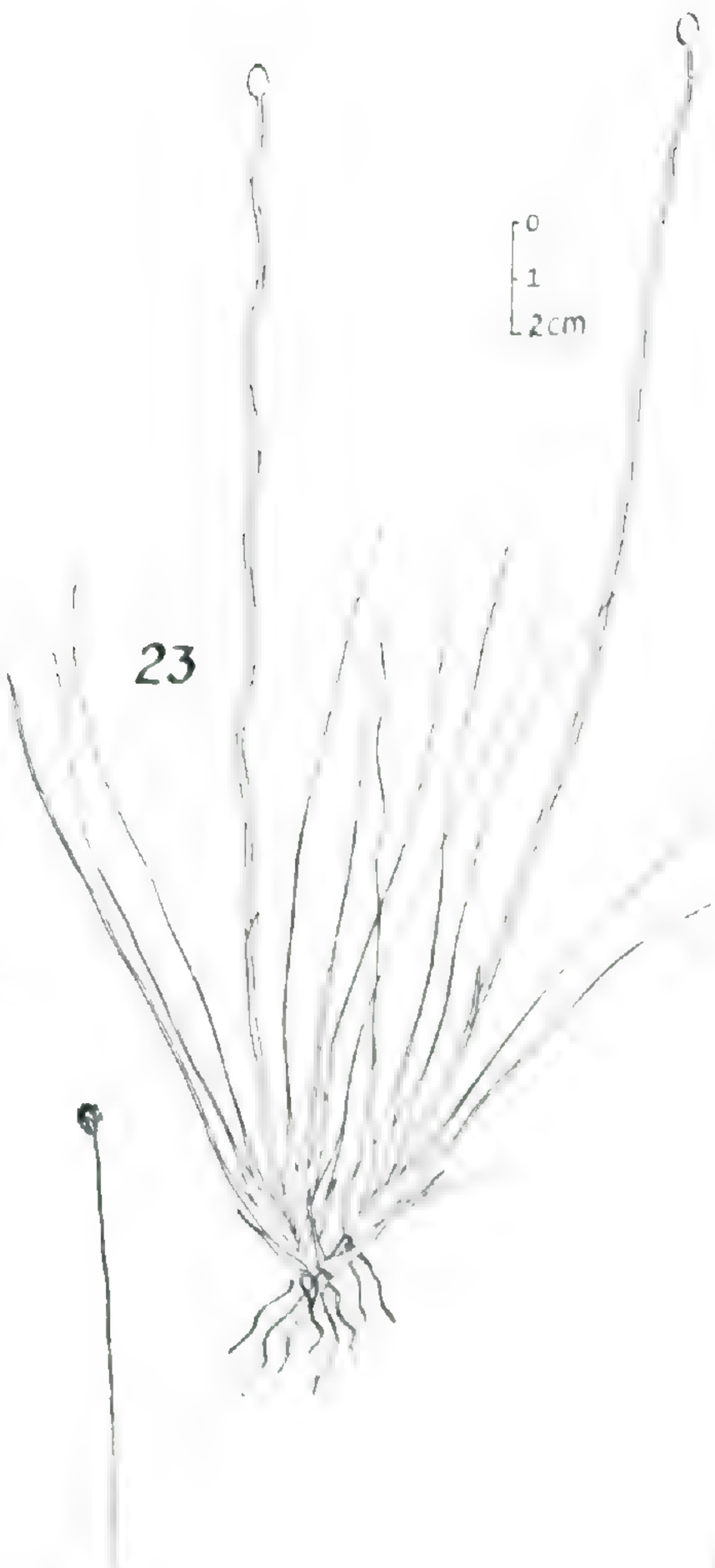

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Figs. 22 - 26. Outline sketches of some *Xyris* species. Fig. 22. *X. ambigua*; fig. 23. *X. baldwiniana*; fig. 24. *X. brevifolia*; fig. 25. *X. drummondii*; fig. 26. *X. elliottii*.

in relation to the leaves, and they are often somewhat flattened distally. A very good floral difference is emphasized by Dr. Blomquist (1955) ; the staminodes of *X. baldwiniana* are quite smooth while those of all other North American *Xyris* are fimbriate.

12. **Xyris elliottii** Chapm., Fl. S. US. 500. 1860. Figs. 11, 26. Tufted, *hard-shiny-brown-based* perennials, often in clumps of 100 or more. Leaf linear to narrowly linear, 10-30 cm long, 1-2 (-2.5) mm broad, flat to slightly twisted, minutely tuberculate to smooth along the *pale, prominent, cartilaginous margin,* otherwise papillose or smooth; tip acute to acuminate; equitant portion 1/8-1/4 the total length of the leaf, the *base hard, brown, abruptly but not broadly dilated, often persistent as chaffy fragments.* Scape 40-60 (-70) cm long, slightly twisted, terete with one to several low ridges below, oval or somewhat flattened in cross section and smooth (or with up to four low ridges) above, the ridges if present minutely tuberculate; sheath of the scape close, 8-14 cm long, with a short, ascending blade. Spike 6-15 mm long, broadly elliptic to ovoid, acute, of several closely imbricate bracts. Fertile bracts 5-6 mm long, obovate, *shreddy at the apex at maturity,* pale to dark brown, dull, with a dull, gray-green, oval or oboval, papillose, dorsal area. Lateral sepals as long as, or slightly longer than, the bracts, the keel increasingly ragged or ascending fimbriate toward the apex. Seeds 0.5-0.6 mm long, ellipsoid, many ribbed.

Moist sands or sandy peats of savannas, pineland pond margins, lakeshores, and roadside ditches, South Carolina south to Florida and west in the Coastal Plain to east Texas.

Type. FLORIDA, FRANKLIN CO.: Apalachicola, *Chapman.*

Florida material examined, by county. Alachua, Brevard, Broward, Charlotte, Citrus, Clay, Collier, Columbia, Dade, Duval, Flagler, Franklin, Gulf, Hardee, Hernando, Highlands, Hillsboro, Indian River, Lafayette, Lake, Lee, Leon, Levy, Liberty, Manatee, Marion, Martin, Nassau, Okaloosa, Orange, Osceola, Palm Beach, Pasco, Pinellas, Polk, Putnam, Santa Rosa, Sarasota, St. Johns, Sumter, Taylor, Union, Volusia, Wakulla, Washington.

Xyris elliottii is a gregarious species, often forming clumps of a hundred or more plants. During the early summer months the borders of many peninsular Florida lakes and ponds are turned to gold by countless thousands of flowering spikes of this species. The narrowly linear, sometimes twisted leaves of *X. elliottii* are usually cartilaginous-margined. This margin becomes particularly conspicuous on the herbarium specimen, showing as a fine white to yellowish-white (usually papillate) band in sharp contrast to the blade proper which dries to a dark green or brown.

However, leaf-widths and -lengths are highly variable in *X. elliottii.* A narrower-leaved form with minor differences such as a less prominent margin, less scabrous scape, shorter bracts and smaller heads was given varietal status by Malme *(X. elliottii* var. *stenotera).* Further study and evaluation of this latter putative entity and of Malme's *X. baldwiniana* var. *tenuifolia* are desirable.

The hard spikes of *X. elliottii* have a dull brown appearance. This effect is augmented by the ragged apices of the bracts. Some individuals have been described as having slightly exserted sepals, yet this is not reliable as a field character. The drying of specimens often causes expansion and opening of the bracts which makes the lateral sepals far more conspicuous than they are on the living plants.

13. **Xyris fimbriata** Ell., Bot. S. C. & Ga. 1: 52. 1816. Figs. 2, 16. Solitary or tufted, soft-based biennials (perennials?). Leaf broadly linear, 40-70 cm long, 5-20 mm broad, flat, smooth; tip acute to acuminate; equitant portion about 1/8 the total leaf length, its base usually tan or pale green, slightly dilated. Scape 80-130 cm long, slightly twisted, terete and 1-many ribbed below, 2 to 3 or 4-ribbed and somewhat flattened above, the *ridges evidently tuberculate-scabrid;* sheath of the scape 15-40 cm long, short-bladed. Spike 1.2-2.5 cm long, elliptic-oblong, obovate to oval, entire, dull brown, with a roughly triangular or oval, gray-green, dorsal area. *Lateral sepals conspicuously exserted,* 8-10 mm long, *the lacerate keel expanding into a broadly fimbriate* tip. Seeds 0.8-1.0 mm long, narrowly fusiform, many ribbed.

Sands and peat mucks of pineland pools, roadside ditches, cypress ponds and lake shores, New Jersey south to Florida and west in the Coastal Plain to Mississippi. I have examined Nash's specimen No. 1461 which was cited as an example by Malme (1913).

Type. Type locality "Georgia".

Florida material examined, by county. Bay, Brevard, Dixie, Escambia, Franklin, Highlands, Indian River, Jefferson, Lake, Leon, Madison, Marion, Orange, Santa Rosa, Volusia, Walton, Washington.

Xyris fimbriata is perhaps the tallest species of *Xyris* in our area. It is distinguished from all of our other *Xyris* by its conspicuously exserted, long-fimbriate lateral sepals which give the ovoid spikes a dull brown, shaggy appearance. Seldom is it found in habitats where there is not some standing water; in peninsular Florida it forms heavy stands on the mucks of cypress pond margins or on the submerged sandy peats of *Hypericum* ponds. In such habitats it is frequently found in mixed population with *X. smalliana*

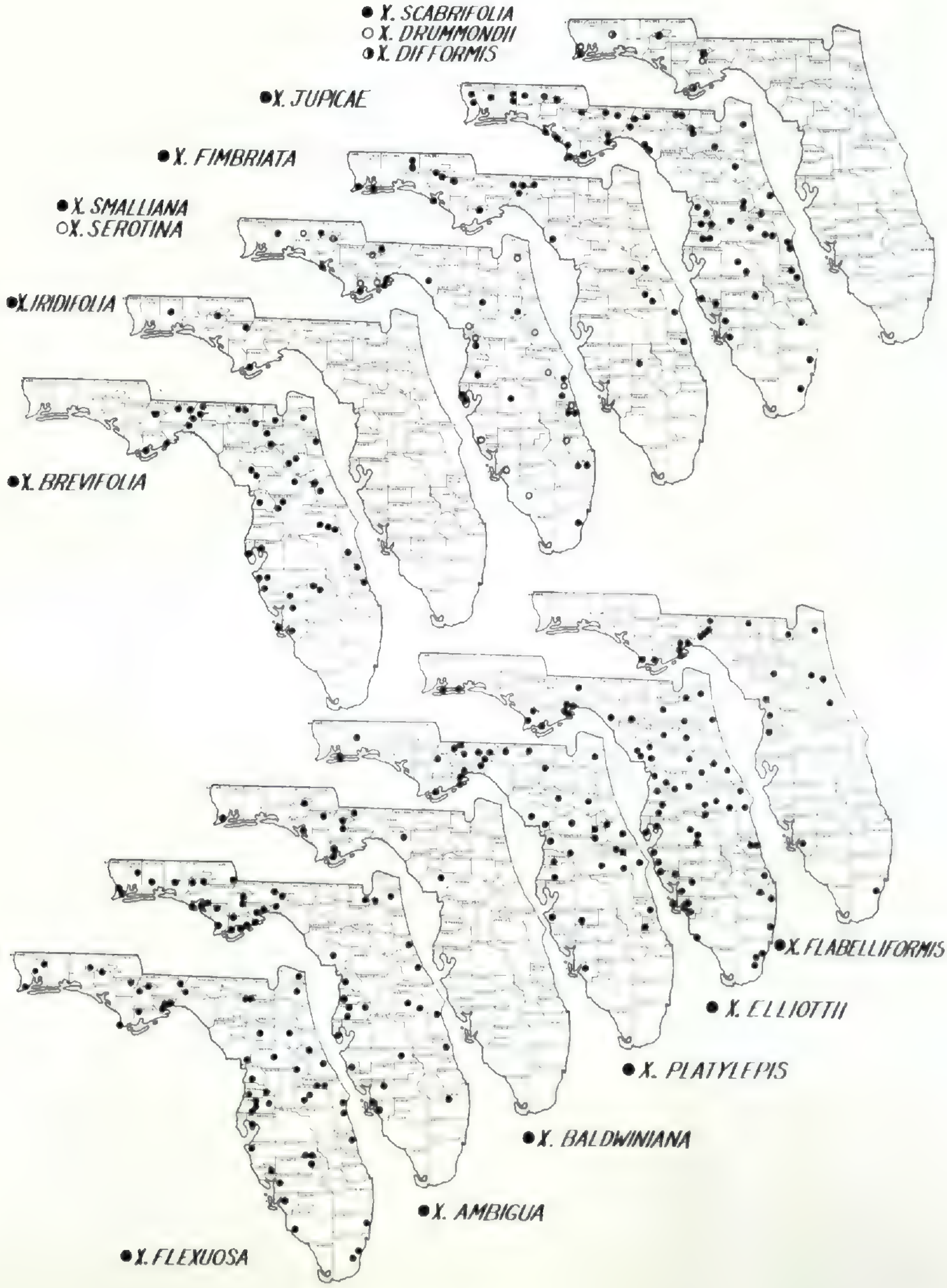

Fig. 27. Distribution maps of 15 species of *Xyris* in Florida.

which it superficially resembles. Yet, in no instance do the two species appear to hybridize.

14. **Xyris smalliana** Nash, Bull. Torrey Bot. Club **22**: 159. 1895. Fig. 14. Solitary to tufted, soft-based, biennials (perennials?). Leaf linear, 30-50 (-60) cm long, 5-15 mm broad, flat or slightly twisted, smooth; tip acute to acuminate; equitant portion 1/16-1/4 the total leaf length, gradually expanding toward the pale green to greenish-tan base where it becomes abruptly dilated. Scape 70-150 cm long, terete and ribless (or 1-ribbed) below, 1-2 ridged and somewhat flattened above, *smooth;* sheath of the scape 15-40 cm long, the erect blade about 1/8 the total length of the sheath. Spike 1.5-2.5 cm long, ellipsoidal or narrowly ovoid, of many closely imbricated bracts. Fertile bracts 5-8 mm long, ovate, entire, shiny brown, with a gray-green elliptic dorsal area. *Lateral sepals slightly to conspicuously exserted,* the jagged keel broadening toward the sepal tip. Seeds 0.6-1.0 mm long, fusiform, inconspicuously ribbed.

Sands and peat-mucks of pineland pools, roadside ditches, cypress ponds, and lake shores, Florida north to Georgia, west along the Gulf Coastal Plain to Louisiana.

Type. FLORIDA. LAKE CO.: in water at Lake Ella, vicinity of Eustis, *Nash 1584.*

Florida material examined, by county. Alachua, Bay, Brevard, Citrus, Dade, Franklin, Gadsden, Hernando, Holmes, Indian River, Lake, Okaloosa, Palm Beach, Pasco, Pinellas, Putnam, Taylor, Wakulla.

Xyris smalliana is, along with *X. fimbriata,* one of the most robust of the Florida *Xyris.* Except for its size and exserted lateral sepals it could, however, be mistaken for some larger forms of *X. jupicai,* with which it often occurs.

15. **Xyris jupicai** L. Rich. Act. Soc. Hist. Nat. Paris **1**: 106. 1792. Figs. 13, 19. *Xyris caroliniana* Walt. Fl. Car. 69. 1788. *Xyris communis* Kunth, Enum. Pl. **4**: 12. 1843. *Xyris elata* Chapm. Fl. S. US. 501. 1860. Solitary, or in tufts by short lateral offshoots, soft-based annual or biennial. *Leaf linear,* 10-60 cm long, 5-10 mm broad, flat to slightly twisted, ascending, smooth to minutely tuberculate along the margins; tip acute; equitant portion gradually broadened to the slightly dilated, yellowish-green or tan base. Scape 20-70 (-90) cm long, terete and one to many-ribbed below, flattened and two to four ribbed above, the ridges smooth or tuberculate scabrid; scape sheathes scarcely inflated above, the divergent blade short. Spike oblong-cylindric to ellipsoidal or ovoid, blunt to acute, 5-15 mm long, of several to many tightly imbricate bracts. Fertile bracts 5-7 mm long, obovate to oval, entire, rounded, tan to castaneous with a gray-green, rectangular to round, dorsal area. Lateral sepals inserted, about the length of the bracts. The keel ragged or sub-entire. Seeds about 0.5 mm long, ovoid, many-ribbed.

Wet sands or sandy peat or roadside ditches, flatwoods pond margins, cypress swamps, and lake shores, Maryland south to Florida and west, chiefly in the Coastal Plain, to Texas and Arkansas.

Type. Not seen by the writer. Type locality, Cayenne.

Florida material examined, by county. Bay, Bradford, Brevard, Broward, Calhoun, Charlotte, Citrus, Columbia, Dade, Duval, Escambia, Franklin, Gadsden, Gulf, Hamilton, Hernando, Highlands, Holmes, Indian River, Jefferson, Lee, Leon, Madison, Okaloosa, Orange, Palm Beach, Pasco, Polk, Putnam, Santa Rosa, Sarasota, Seminole, Taylor, Volusia, Wakulla, Washington.

While Blomquist (1955) recognized *X. caroliniana,* he accepted the name with reservations; the Walter description is indeed inconclusive and could well fit any of at least four species in the genus. Furthermore, it is the opinion of Blomquist (l. c.) and myself that the *X. elata* of Chapman as treated by Malme is nothing more than a form of *X. jupicai.* Herbarium sheets of this latter species show a great variety of identifications: *X. caroliniana, X. communis, X. elata* and *X. difformis* being names most frequently used. While Gleason (1952) utilizes the inadequately typified Walter epithet "caroliniana" to include the complex, his view is indeed expressive of the difficulties one meets in treating it.

> "Variable in stature, leaf-width, size and shape of spikes, and imbrications of the bracts. On the basis of these structures, recent authors distinguish as many as four species within our range, all of which are so connected by intermediate forms that a sharp separation appears impossible, even though the extremes may appear distinct (*X. difformis* Gray, Small; *X. elata,* Gray, B. & B., Small; *X. communis* B. & B., Small)."

The earliest adequately typified name for the spectrum of forms identified as *X. elata, X. communis, X. caroliniana,* appears to be *X. jupicai* Rich., which is without doubt the commonest, most expressive, and weediest species of *Xyris* in the state of Florida.

16. **Xyris difformis** Chapman, Fl. S. US. 500. 1860. Similar to *Xyris jupicai* but with *leaves (broadest toward or above the middle), often pinkish-based,* usually with minutely scabrous margins, and flabellately arranged. *Scape* 20-70 cm long, *flattened and conspicuously two-ridged above, the ridges usually scabrid.* Spike oblong-cylindric to ovoid, 5-15 cm long, of several to many tightly imbricate bracts. Fertile bracts as in *X. jupicai.* Lateral sepals inserted about the length of the bracts, the keel ragged. Seeds about 0.5 mm long, ovoid many ribbed.

Wet sands or sandy peat of flatwoods pond margins, stream banks, and lake shores, Maryland south to north Florida and west in the Coastal Plain to Texas.

Type. FLORIDA. FRANKLIN CO.: marshes, Apalachicola, *Chapman.*

This species, so abundant in coastal Virginia and North Carolina, appears to be quite rare in Florida; it is thus surprising that Chapman would have been the first to describe it. The writer, after looking at a number of Florida specimens identified as *X. difformis* but which were actually forms of *X. jupicai,* was not convinced of the distinctness of the former. His concept of *X. difformis* was later clarified through a conversation with Dr. Blomquist and a consultation of material of that species on deposit at the Duke University Herbarium. Unquestionably, populations of this entity which have the flabellately arranged, purplish-based leaves together with broad (by comparison with *X. jupicai*) upper scape ridges are quite distinct.

A difficulty that will probably arise in any revision of the North American species will be in determining the relationships between *X. difformis, X. jupicai* and *X. serotina.* Habit and coloration serve to separate most specimens of *X. difformis* from *X. jupicai,* but degree of scabrousness alone serves to separate *X. difformis* from that variety of *X. serotina* which does not have farinose seeds. The description of Walter (l. c.) calls for a species with gladiate leaves but, unfortunately, does not include a comment on scabrousness; thus it could indiscriminately be applied (and has been by some workers) to both *X. difformis* and *X. serotina.* It is not unlikely that future study will disclose subspecies (instead of what we now consider three species, *X. difformis, X. serotina, X. curtissii*) distinguishable morphologically on the basis of farinose versus clear seeds, degree of scabridity or papillosity, and breadth and flatness of the upper scape. However, this remains to be clarified through the study of an even larger series of specimens than I have worked with at present, together with a careful field appraisal of these taxa over their entire range. — DEPT. OF BIOLOGY, VIRGINIA POLYTECHNIC INSTITUTE, BLACKSBURG, VA.

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CHANGES IN STATUS AND NEW COMBINATIONS FOR CERTAIN TAXA IN THE OKLAHOMA FLORA[1]

U. T. WATERFALL

For more than 20 years the author has been engaged in a study of the Oklahoma flora. During that time he has travelled approximately 140,000 miles within the state, and has made many collections, especially in the areas in, or near, the corners of the state where floristic differences have made the investigations quite interesting.

He has added 235 species, mostly collected by him on these trips, to the known flora of the state. Reports of these, together with descriptions of new taxa and data concerning geographical distributions have been published in a series of 25 papers, the majority of which have appeared in Rhodora.

In April, 1960, he made available his "Keys to the Flora of Oklahoma". As the name indicates, it provides keys for the determination of taxa, down through the category of

[1]Studies in the Composition and distribution of the Oklahoma Flora — No. 26.

forma, which he currently regards as occurring within the state. This multilithed publication is regarded as a temporary expedient intended to present some usable account of the state's flora, pending its eventual expansion into a Flora.

In these "Keys" a few transfers and combinations are indicated, but not actually made. Name-bringing synonymy is not included, and the author is doubtful if such a temporary publication fulfils well the requirements for effective and valid publication of the International Code.

However, since these combinations should be correctly and effectively published so they may be available for use in the future, they follow below.

Selaginella arenicola Underw., var. **Riddellii** (Van Eselt.) Waterfall, stat. nov. based on *S. Riddellii* Van Eselt., Contrib. U. S. Nat. Herb. **20:** 162. 1918. *S. arenicola* Underw., ssp. *Riddellii* (Van Eselt.) Tryon, Ann. Missouri Bot. Gard. **42:** 24. 1955.

The author concludes that a ternary combination under *S. arenicola* best indicates the relationship of this taxon. However, it seems that the varietal status is indicated for uniformity of treatment in this area.

Another related taxon should be made available in the category of varietas for those who prefer to use this designation for this concept. It is **Selaginella arenicola** Underw., var. **acanthonota** (Underw.) Waterfall, stat. nov. based on *S. acanthonota* Underw., Torreya **2:** 172. 1902; *S. rupestris* (L.) Spring, var. *acanthonota* (Underw.) Clute, Fern Allies: 142, 264. 1905; *S. arenicola*, ssp. *acanthonota* (Underw.) Tryon, Ann. Missouri Bot. Gard. **42:** 26. 1955.

Eustoma grandiflorum (Raf.) Shinners, forma **album** (Holzinger) Waterfall, comb. nov. based on *Eustoma Russellianum* Griseb., forma *alba* Holzinger, Contrib. U. S. Nat. Herb. **1:** 211. 1892. *E. Russellianum*, forma *Fisheri* Standl., Rhodora **34:** 176. 1932; *E. grandiflora*, forma *Fisheri* (Standl.) Shinners, Southw. Nat. **2:** 41. 1957.

Although brief, Holzinger's description seems adequate to differentiate this taxon from the typical one. It reads "The plants collected in Neutral Strip are white flowered, but otherwise practically like the species. They may, therefore, be known as 'forma alba' of this species."

Aster paludosus Ait., var. **hemisphericus** (Alexander) Waterfall, stat. nov. based on *A. hemisphericus* Alexander in Small, Manual of the Southeastern Flora: 1391 & 1509. 1933. *A. paludosus* Ait., ssp. *hemisphericus* (Alexander) Cronquist, Bull. Torrey Club **74:** 145. 1947; *Heleastrum hemisphericum* (Alexander) Shinners, Field & Lab. **17:** 170. 1949.

In our herbarium we have material from Cherokee, Delaware, Latimer, LeFlore, Mayes, Ottawa, Pushmataha and Sequoyah Counties in eastern Oklahoma.

Gaillardia lanceolata Michx., var. **fastigiata** (Greene) Waterfall, comb. et stat. nov. based on *G. fastigiata* Greene, Pittonia **5**: 57. 1902. *G. rigida Small,* N. Am. Fl. **34**(2) : 135. 1915.

Although the peduncles of much of our material assigned to *G. fastigiata* are definitely shorter than those of eastern material referred to *G. lanceolata,* there is quite a bit of variation in this characteristic, and not all specimens can be assigned easily to either taxon. Therefore it seems more significant to relegate this taxon to the varietal status.

Haplopappus divaricatus (Nutt.) Gray, var. **Hookerianus** (T. & G.) Waterfall, comb. nov. based on *Isopappus Hookerianus* T. & G., Fl. N. Am. **2**: 239. 1842. *Haplopappus Hookerianus* (T. & G.) Gray, Syn. Fl. 1(2) : 131. 1884; *Croptilon Hookerianum* (T. & G.) House, N. Y. State Mus. Bull. **233-234**: 61. 1921; *Isopappus validus* Rydb., Brittonia 1: 100. 1931; *Haplopappus validus* (Rydb.) Cory, Rhodora **38**: 407. 1936; *Isopappus divaricatus* (Nutt.) T. & G., var. *Hookerianus* (T. & G.) Shinners, Field & Lab. **18**: 157. 1950; *Croptilon divaricatum* (Nutt.) T. & G., var. *Hookerianum* (T. & G.) Shinners, Field & Lab. **19**: 134. 1951.

This is the more robust variety with well-developed heads usually 6-10 mm. wide and usually with 10-15 ray flowers per head. It is found over much of Oklahoma, especially in sandy areas, whereas var. *divaricatus,* with heads usually 4-5 mm. wide and usually with 5-7 ray-flowers, is found in southeastern Oklahoma, mostly in McCurtain County.

Haplopappus phyllocephalus DC., var. **annuus** (Rydb.) Waterfall, stat. nov. based on *Sideranthus annuus* Rydb., Bull. Torrey Club **31**: 653. 1904. *Haplopappus phyllocephalus* DC., ssp. *annuus* (Rydb.) Hall, The Genus Haplopappus, Carnegie Inst. Publ. No. 389. 58. 1928.

This is the only representative of *H. phyllocephalus* found in our state. It is not common, but is found scattered on sand along rivers in the central and western parts of Oklahoma. According to Hall (l. c. supra) it extends to eastern Colorado and southern Texas.

Along the coast of the Gulf of Mexico another variety is to be found. It is **Haplopappus phyllocephalus** DC., var. **megacephalus** (Nash) Waterfall, stat. nov. based on *Eriocarpum megacephalum* Nash, Bull. Torrey Club **23**: 107. 1896. *Haplopappus megacephalus* (Nash) Hitchcock, Trans. Kans. Acad. **16**: 131. 1899; *Sideranthus megacephalus* (Nash) Small, Fl. Se. U. S. 1185. 1903.

Helenium amarum Raf., var. **badium** (Gray) Waterfall, comb. nov. based on *H. tenuifolium* Nutt., var. *badium* Gray in Wats. Proc. Am. Acad. **18**: 108. 1883. *H. badium* (Gray) Greene, Pittonia **5**: 55. 1902.

This variety, with its small heads and purple-brown disc-flowers contrasting with the larger heads and yellow disc-flowers of var. *amarum (H. tenuifolium* Nutt.), is found in southwestern Oklahoma in the Wichita Mountains and vicinity. — DEPARTMENT OF BOTANY AND PLANT PATHOLOGY AND THE RESEARCH FOUNDATION, OKLAHOMA STATE UNIVERSITY, STILLWATER.

SANDBAGS AS A TECHNICAL AID IN MOUNTING PLANTS. — Sandbags as an aid in mounting plants with glue have recently been tested at the University of Michigan and found to be not only important timesavers, but also a more dependable source of pressure for good mounts. Such bags have been used for years at Kew Herbarium in England. Because of their relative novelty in this country and their proven effectiveness, it was thought that a description of their design and function might be helpful.

When plants are mounted with glue, it is necessary to press them firmly against the herbarium sheet until the glue is dry to achieve good adhesion. Obviously, portions which are able to spring away from the paper will not be fastened securely. If specimens are thin and flat this presents no difficulty. But if they have thick parts that interfere with applying pressure to the thinner parts, some ingenuity is required to insure good contact everywhere. A hickory branchlet with nuts and heavy stems, for example, needs extra care on the leafy portions, so that fruits, stems, and leaves will alike be properly pressed against the paper.

One way to equalize the uneven surfaces of such a specimen is to add pads of appropriate thickness to the thinner portions until a relatively level surface is presented to the applied weight. The pads may be made of folded newsprint, or some other suitable material. This method gives satisfactory results, but often demands a burdensome amount of attention and time.

Sandbags offer a much quicker and simpler solution. After a specimen is undercoated with glue, placed on a herbarium sheet, blotted, and covered with a waxed paper, a sandbag, which is the equivalent of both weight and pads, is laid over it. Fingertips can readily force it to bear down closely on each leaf, fruit, or stem. The bag's lower surface is made to accommodate itself to the contours of the plant, and its upper surface can be neatly smoothed to receive subsequent layers in the stack of processed specimens. Pressure is distributed effectively across each sheet, and from layer to layer. While it is possible to place another herbarium sheet and specimen directly upon the preceding sandbag, it

has been found preferable to insert first a thin section of plywood or fibreboard, or even heavy cardboard, to provide a more rigid area of support. Each glued sheet should rest on a flat, inflexible surface to prevent warping. It is also desirable to place a blotter under each sheet to help remove moisture introduced by the glue. Leaving the bags in place overnight is usually long enough, unless the atmosphere is exceedingly humid. Plants which did not receive proper pressing when collected are greatly improved in flatness and general appearance after treatment with glue and sandbags.

Though the idea of using sandbags as weights was borrowed from Kew, those described here are of a somewhat modified design. Ours at the University of Michigan resemble flat pillows, about 1½ inches thick, slightly wider and longer than standard American herbarium sheets. Tightly woven unbleached muslin was chosen for the fabric, as this material seemed to offer the best combination of strength and flexibility. Mined silica sand was used as the filler, because it is white and relatively dirt-free. A small but perceptible amount of dust unavoidably escapes through the cloth when the bags are kneaded or shifted about. A standard width of muslin available for making bedsheets, 81 inches, was found to yield six bags per yard without waste. Each third of a half-yard, folded and closed with double-stitched half-inch seams, and filled with 12 pounds of sand made a pillow of exactly the right dimensions and maneuverability.

Cost of materials averaged about 29 cents for each bag. The muslin was a dollar a yard, and the sand $1.39 per hundred pounds. About 18 hours of labor were necessary for cutting, sewing, and filling 54 bags.

If specimens are particularly bulky, and a separate bag is required for every sheet, a mounter may need 35 to 50 bags in a full day of gluing. It appears from our preliminary tests that a worker's output when doing specimens of this type is approximately doubled. The sandbag method is not only quicker, but far less arduous. It appeals greatly to mounters because countless small decisions and stratagems are no longer necessary. The annoyance of providing prop-

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RHODORA

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

REED CLARK ROLLINS, Editor-in-Chief

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

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Address manuscripts and proofs to Reed C. Rollins,
Gray Herbarium, 22 Divinity Avenue, Cambridge 38, Mass.

Subscriptions and orders for back issues (making all remittances payable to RHODORA) should be sent to Albert F. Hill, Botanical Museum, Oxford Street, Cambridge 38, Mass.

Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

Rhodora

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NEW ENGLAND BOTANICAL CLUB

Vol. 62 December, 1960 No. 744

SIDNEY FAY BLAKE
1892-1959

BERNICE G. SCHUBERT[1]

Sidney Fay Blake, who died on the last day of 1959, left as a legacy to his colleagues what will become one of their most useful reference tools, his Geographical Guide to the Floras of the World — Part II[2]. Although, in his last years, effort toward the completion of this work consumed the greatest part of Dr. Blake's time and energy, other long-standing pursuits were not neglected and his days were filled with interest and activity to the very end.

Sidney Blake was born on August 31, 1892, in Stoughton, Massachusetts, where he lived until he finished his graduate studies and where he returned for holidays regularly throughout his life. From his early youth he was keenly interested in Natural History, chiefly in birds until his later high school years, when an interest in plants became dominant. He then began his study of the flora of Stoughton, carried on intermittently throughout his life, and essentially completed for publication on his last visit to Massachusetts in September 1959. He entered Harvard College as an undergraduate in September 1908 and remained in some status at the University until his appointment as assistant botanist in the United States Department of Agriculture in 1918.

Since the details of his early years have been ably recorded elsewhere by the person best qualified to write of them, his

[1]Taxonomist, Crops Research Division, ARS, USDA, Beltsville, Maryland.

[2]Part I published, with Alice C. Atwood as junior author, in 1942; Part II to be published in early 1961.

friend from early childhood and later his wife, Doris Holmes Blake[3], I shall write here about a phase of Dr. Blake's life which he recorded himself. In letters to his two professors at the Gray Herbarium of Harvard University[4], Benjamin Lincoln Robinson, Asa Gray Professor of Botany, and Merritt Lyndon Fernald, Fisher Professor of Natural History (Botany), from 1910 to 1918, many aspects of his personality and working habits become clear. My personal acquaintance with Dr. Blake began during my graduate study at the Gray Herbarium some twenty years ago. His friendly interest in my work continued in a most helpful fashion from that time until his death, including the years from 1952 on, when we were colleagues at the Plant Industry Station, Beltsville, Maryland. Of these years also I shall write briefly.

Sidney Blake entered college with an unusual knowledge of research methods and scientific procedures and early in his undergraduate career began to present papers for publication. In 1910, when a junior at Harvard and eighteen years old, he had three short botanical papers published. During this year too, he entered into his first controversy on botanical nomenclature, a subject with which, from interest or professional obligation, he was to become more or less involved for the rest of his life. At that time he had not clearly made the break from zoological to botanical nomenclature and was rather in favor of adapting some procedures of the former code to the latter rather than considering the two as distinct areas. In March 1910 he wrote to Dr. Robinson: "I am perfectly willing to insert that triliteral 'var.' and thus cut out the trinomial. My objections to the former arise, I suppose, principally from the fact that I learned nomenclature in the study of ornithology, and from that science the objectionable 'var.', or the Greek letter which frequently took its place, has been banished for twenty years and more, for the reason that it was absolutely no use . . . As to the difference in meaning of *variety*, *subspecies*, and

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[3]Published in Taxon 9 (5): 129-141. 1960.

[4]These letters kindly loaned me by Dr. Reed C. Rollins, Director of the Gray Herbarium and the present Asa Gray Professor of Botany.

form, as employed in botany, I am in the dark. . . The calling of cristate forms of Polypodium and Pellaea *varieties* seems to be an abuse of the term. I should call them forms, as indeed is done in very many similar cases in the 7th edition of the Manual, in speaking of the plants, but not in giving their scientific designation. What you would call subspecies are probably those forms, designated as varieties, which are distinguished in Gray's Manual by heavy type

S. F. Blake — France, 1950

and separate paragraphing. If these plants really represent a different degree of differentiation why is it not expressed by the abbreviation subsp.? Although their distinctness is sufficiently obvious in the case of the Manual, when one quotes a name from that book of what value is the heavy type and separate paragraph in that volume going to be, if one uses the word 'var.' as is there done?" Unfortunately the reply to this letter is not extant.

The only letter *to* Blake of that period, of which we have a copy, is dated June 22, 1910, from Professor Fernald, for the editors of Rhodora. In this a note on a fern is rejected because "it has been the policy to decline articles in which

the author in the same article follows two distinct codes of nomenclature." The paper was not published, but other notes on ferns appeared in Rhodora the following year. So, he learned early, and from actual practice, the principles of the discipline he was to follow. There apparently was no question of the validity of his botanical discoveries, chiefly new records for his area, but of the form in which he presented his findings. His keen eye for collecting was well trained and his bibliographical interests initiated by the time he had finished his undergraduate studies, with honors, in 1912.

In the spring of 1913, his first year of graduate work, Blake made his initial visit to the herbarium of the Smithsonian Institution in Washington. There, during two months of study, he solved some of his botanical problems; but he found others: among some of the questions involved in Walter's Flora Caroliniana was one, concerning a name in the Umbelliferae that he discussed in a letter to Dr. Robinson on July 2nd. In an earlier note to Professor Fernald he had written of his first collecting trip in Virginia where he "Took any quantity of things new to me — Aplectrum, clusters of Conopholis with great swollen misshapen rootstocks, Gillenia, Red Birch, many Carices, several Butter cups, and any quantity of other things. Have been putting them up until I just now (2:50 A. M.) ran out of sheets so I believe I will go to bed."

Up to this time the letters are brief, concerned with specific problems, written only during temporary absences from the Gray Herbarium. In August 1913, during a collecting trip of about six weeks to the province of New Brunswick, in eastern Canada, his more or less weekly letters to Professor Fernald are full of interest in his collections, pleasure in his field experiences, and amusement at the details of living in a somewhat foreign atmosphere and the minor mishaps and calamities which occur to all collectors. From his first headquarters in Bathurst he wrote with some glee: "It seems that the Sunday before I arrived the priest had been telling his flock of some sort of agricultural expert, who was to appear soon in the district and travel about visiting the sick

and afflicted orchards, cornfields, and strawberry beds of the parish recalling them to a life of renewed fruitfulness, so I when I appeared . . . was hailed as the aforesaid Messiah, and I almost think that some of them still think I am really he, and shamefully shirking my work to loaf around the seashore. . .." He wrote in detail of his collections and probable new records, since Professor Fernald had a special interest in this area. *Lycopodium tristachyum* he considered the best of his early finds, because it had not been previously recorded north of northern Maine. From the Bathurst headquarters he made short trips by all kinds of transportation for several weeks, and noted his difficulties in some detail: "Monday the 25th I again risked my life by taking the Caraquet Ry. . . The train plugs along over a one-track road . . . yanking the cars ahead and then letting them sag back, . . . and if luck and the wind are with her she covers 26 miles in two hours." From Miscou he sent "scraps" of collections of *Atriplex, Salicornia,* and *Polygonum* which constituted records or were new to science. From Newcastle, N. B., he wrote of a visit to the Natural History museum in Chatham to check the herbarium, and included a list with many corrections of published records from the area which had been based on previous misidentifications of the specimens. A few hastily written postcards telling of the latest finds end the correspondence of this collecting trip which seemed to have been profitable and refreshing.

The correspondence recommenced on December 21, 1913, when Sidney Blake arrived in London to begin a period of study as a Sheldon Travelling Fellow of Harvard University, and continued until July 1915. During this period of world turmoil, in which he was himself somewhat enmeshed, he managed nevertheless to accomplish a rather phenomenal amount of botanical work, including solution of many monographic, floristic, and bibliographical problems. The facets of Blake's character most clearly revealed in these letters are his quiet confidence and mature approach to his research studies. He apparently had no hesitancy about the path he wished to follow, no doubt about his ability to cope with the problems as they arose,

and no hint of either false modesty or false pride in his efforts, only a simple satisfaction in each task as he accomplished it and an eagerness to take up the next one.

The first botanical questions to occupy Sidney Blake during his early months in England (from late December, 1913 to mid May, 1914), were related to the genera of which he had collected representatives the previous summer, among them *Atriplex*, *Salicornia*, and *Polygonum*. His conclusions concerning these and many other problems were published in the following years and form a part of his very sizeable bibliography. He enjoyed and profited from his association with the many British and European botanists and wrote at some length of their assistance. He was very careful, however, to draw his own conclusions and was not influenced to accept opinions he thought unsound or inadequate. Of Mr. Moss "who seemed very glad to help me with Salicornia" he later wrote (to M. L. Fernald, February 27, 1914): "I don't remember whether I wrote you that Moss had given me a fine series of types and typical specimens of his *Salicornias* — which nevertheless doesn't make me think any better of his new species. *S. disarticulata* is beautifully distinct, but the others as the English say are *rotters*. He doesn't impress one as being particularly cautious (he identified two of our things with his at first, only to reject them afterward) or especially careful about verifying details in a series of specimens." And later, in discussing Moss's forthcoming Cambridge British Flora (same letter) wrote: "Moss' idea of sections and subgenera is good I believe, and I shall not disagree with his ideas as to their nomenclature. However the plates, about which he is very enthusiastic, are mostly not at all good in their rendering of details, and the almost lack of measurements (especially bad when new forms are described as 'smaller in all their parts' &c.) is very unfortunate." He seems, however, to have enjoyed his visits with Moss and to have done some collecting during them, for he wrote in an early letter from Paris (to M. L. Fernald, Paris, May 15, 1914): "P.S. While visiting Dr. Moss at Easter I collected some *Caltha palustris* and had it cooked

and then ate it. It wasn't particularly attractive, and Mrs. Moss said it smelled very badly while it was being cooked, but it certainly had no ill effects. Shall have to try the American one when I get the chance, for I have never eaten that, and it may be that some varietal difference would appear in its reaction."

Many of Blake's letters gave detailed accounts of his solutions to the various problems he was attacking, with the help of one or another colleague or by study of types or more adequate collections. *Rosa blanda,* he wrote (January 11, 1914) "With Dr. Rendle's help I have succeeded in straightening out . . . *Cochlearia* has turned out very interesting also, and I have succeeded in identifying all but two or three of our forms. The very rounded-podded long-styled species, typified by F[ernald] & W[iegand] 3467, is a good n. sp., and #3468 is a splendid match for the types of the obscure *C. tridactylites* Banks, which seems to be a quite distinct species. *C. fenestrata* R. Br. is quite as interpreted in Dr. Robinson's revision. *C. danica* is a very distinct little species; one or two of Richardson's sheets labeled that are not it, and I do not believe it occurs in America. Our *C. officinalis* is certainly distinct from the ordinary European plant passing under that name, but a short-style plant also with pods like ours occurs rarely in the Herbaria from Europe. *C. groenlandica* seems to be either very rare or much confused. Am going very soon to the Linnean Herbarium to examine the types of these last two species, and shall then I hope be able to finish up this genus and write you the results."

Some of his time also was occupied with checking collections or comparing specimens for the botanists at the Gray Herbarium and part of it with becoming acquainted with London and its surroundings. He wrote to Professor Fernald (February 2, 1914) "Today I finished the Nfd. list [checking Newfoundland collections at Professor Fernald's request] at the British Museum and tomorrow start in with Polygonum, which will doubtless be hard enough. Some German or Swedish botanist has recently worked up *aviculare,* so that there will be some guideposts on the way. The

weather has been very springlike for the last week, and the robins, blackbirds, starlings, & misselthrushes have been tuning up, & last Saturday I heard the skylark's flight song at the Hendon aerodrome. I spend about one day a week sightseeing and the rest in botany, and am enjoying my trip immensely. Have mastered the English coinage, and can even understand a brakeman calling off stations in the underground — sometimes."

In the last letter before leaving for Paris (to B. L. Robinson, April 3, 1914) Blake discussed seven genera on which he made some studies, not all of them conclusive, for he wrote of the *Urtica* species "They are by far the most troublesome lot I have had to deal with so far excepting *Salicornia*, which is now left in very much the same condition as it was before, Moss' splitting being of very little help with our forms, and rather overdone as regards the English ones. As to *Capsella*, of which I brought over about forty sheets, I am afraid I won't be able to accomplish much. Nobody in England will confess to knowing the group, and without breeding them I doubt if any definite decisions could be reached."

In the first letter from Paris (to M. L. Fernald, May 15, 1914) he rather sums up the difficulties and then later expresses his great joy in his work: "(One of the troubles in England at present seems to be the amateur specialists, compared with whom Rafinesque and Rydberg are almost lumpers. Rosa, Hieracium, and Rubus are of course the worst labyrinths, but there are plenty of other genera that these people insist on splitting into the minutest of 'small species'.) . . . I am ever so much obliged to you and Dr. Robinson for getting the fellowship renewed for another year. It was a thing I hadn't dared to hope for, but the time won't be any too long to look up the various questions that are coming up all the time. You will I hope have some more lists of species for me to look up. I enjoyed that Newfoundland work, getting in touch with the old American collectors and literature, and perhaps next fall you may want some of the La Pylaie plants looked up." In the same letter he writes with some amusement: "Last Saturday

night I went to the Folies-Bergères and was very much startled at the first thing thrown on the screen, which was *Drosera rotundifolia* in the act of capturing a fly! It was followed by *Pinguicula*, said to be 'common in North America', *Sarracenia flava* or one of the other slender southern species said to have 'originally come from Canada', and *Dionaea*; but the program after that was not particularly botanical! . . . and tonight in a restaurant in the Latin Quarter I had the pleasure of being taken for a Frenchman by an American girl and her mother . . . and being asked for the salt in worse French than my own. She must have been a little disconcerted when I asked it back in English a little while afterwards."

From Geneva in July there was a short note with answers to questions; from Berlin on August 12th to Professor Fernald, a postcard written in German script, and giving the first hint of world difficulties[5]: "I have been here for two weeks; how much longer I must remain I do not know. England has cut the German cable, so we can think what we please about the war; we have no news at all from America. But I must admit that Americans here in Germany are very well treated, in spite of what England has perhaps indicated. Miss Perkins, in the Museum, is very friendly, and I am very happy not to be entirely alone. I have enough to do in the Museum if I have to remain for a few months, but I hope that does not happen. I have been considering the idea of working with the genera Viguiera and Flourensia, as Dr. Robinson has suggested . . ."

On August 25th Blake had arrived safely in London and wrote to Professor Fernald what seems to me a most penetrating letter here quoted almost entirely:

"I don't think I was ever in my life as glad to get anywhere as I was to get home to London last Friday night, after two days of most uncomfortable traveling. Miss Perkins, who was very kind to me while I was at Berlin, had her sailing booked for 12 September, and at first planned to come with me and wait till that date in Rotterdam, but

[5] I am grateful to Mr. Paul G. Russell for this translation.

at the last moment changed her mind and decided to stay at Berlin till about 1 September. If she does so she may never get out, for German attacks in Holland are expected any day, and once they come there is absolutely no escape for Americans, or of course anybody else — for Italy is to be closed in a few days, when she will declare herself against Germany, without the shadow of a doubt. Then let the Cossacks get down in Berlin, as they will in the end, and an American's life is worth no more than a German's. There were 400 Americans and German-Americans on our special train, and every one of us I believe was progermanic. You see in Berlin they had filled us with tales of the Russians — who are not the vital issue in this war, but will be in the next, in the event of the allies' success in this struggle; and win they *must* — and it seemed to us that Europe was threatened with the plague of Tsardom. It is not — yet; but it is threatened with the merciless domination of a tyrannical Prussian militarism, which has already shown its true nature by demanding $40,000,000 indemnity of a city it has just conquered, which according to a speech I heard in front of the Reichstagsgebäude intends to get five times the amount this time that it got in '71 out of France, and will 'erasieren' all France from the map in addition, and which engineered this war from the start with the view of capturing Belgium and Holland and what it could take of France. At least I don't see what other view is logical. Austria knew well enough that Servia would never submit to having Austrians sit in judgment in her courts; therefore she intended war; and it was clear enough that Russia must come in, since she would not permit the acquisition of more Slav territory by Austria. Austria would never have risked Russia without German (i.e. Prussian) backing, therefore in spite of her specious attempts at peace-making Germany must also have foreseen the war, and wanted it too, for without her support Austria would never have dared defy Russia. France of course had to come in with Russia, and England just as certainly once Germany attacked Belgium. Germany's absolutely wonderful systemization of everything, whose worst draw-

back is its destruction of initiative in the people, has carried it thru so far; their mobilization of millions of men, carried thru in eight days without a hitch, is the greatest thing of the kind in history. The deciding factor in the land struggle seems to me to be Russia, whose strength is a doubtful quantity; how much has she improved since 1905? France and the rest of them, England included, are almost certain to fall before Germany's army; if Russia does too, all is lost on land. The hope of the allies is to starve out Germany; if England can only prevent the importation of food, Germany must give in in time. But the conflict is one that may drag on for years."

This, the longest non-botanical statement in the whole Blake correspondence, with its clear perception and its telling prophecy gives a fair view of Sidney Blake's keen and clear thinking. He continued this letter with an account of his work in Berlin, mentioning particularly the Compositae in which he had become strongly interested and in which he had found some new species, *Simsia*, *Flourensia*, and *Viguiera*, as well as a wholly new genus, for all of which he left descriptions which were published in Germany in 1916. He felt that he had enough work to keep him busy for some time in England because "Personally I think the voyage to America is a bit risky at present with so many German cruisers scooting about."

In November 1914 (to M. L. Fernald, November 23) Blake was well settled at his work again in spite of war time inconveniences! "The only lights in the British Museum herbarium now are small ones in the bays, and about all they are useful for is card-cataloging. At Kew there are no lights except in the library, but then there never have been lights there in the herbarium. Any real work has to stop at about four o'clock now, which doesn't give a very long day." He followed with a summation of his work in so far as it affected the plants of the Gray's Manual area and continued ". . . should be very glad if you could let me know of some more species or groups that could be looked up to advantage over here, as I shall not be able to get back to Cambridge now until next fall."

In December (December 7) he sent to his classmate, Harold St. John, a full account of types of *Rumex* in the Linnaean herbarium, which had been requested, and closed rather wistfully "Wish you could spare the time to write a word about Ted Hill, [R. E.] Torrey, Cap [Weston] & the rest. I haven't heard a word from anybody for ages and ages."

During the winter of 1915 a large part of the time was occupied with work on the Compositae, the family on which he was to become the unquestioned American authority, succeeding his professor, B. L. Robinson, who had stimulated his interest in the group. In April he wrote, "I am sending you a paper embodying some of the results of the work I have been doing this winter on various genera of the Compositae . . . I should have preferred to publish these notes in somewhat different form after my return to America, but the appearance of Rydberg's first fascicle of Compositae in the North American Flora has warned me that to secure priority they must be published soon. Most of them are things which I have had under consideration for a considerable length of time, and I should not care to see them all gathered in by Dr. Rydberg." His next letter from England to Dr. Robinson (May 20) indicated his return of the proof of a paper on the Walter Herbarium (at the British Museum), discussed briefly the war as it was affecting his British friends, and closed with "Conscription seems a certainty of the immediate future, and with an upset in the Cabinet, anti-German riots (apparently over now) and weekly Zeppelin visits, we do not lack for excitement." On July 3, he wrote Professor Fernald that he was leaving for two weeks in Scotland "with Baker and two or three friends of his." With this the overseas correspondence ended.

The remaining letters of the Gray Herbarium period (to the end of 1918) when Blake was completing his work for the doctorate were infrequent and concerned chiefly with matters of the moment. They do not add significantly to those already cited. The letters, although presenting most clearly Blake, the young botanist, give a glimpse also of

the naturalist, interested throughout his life in ornithology and in later years in paleontology as well. Among the almost thirty species named for him are two fossil mollusca and a coral of his own collecting. His gentle sense of humor may be observed in his letters along with his delight in somewhat cryptic botanical jokes or puns. His interest in languages was lasting and stood him in good stead in his later bibliographical studies. His avocations, just as his work, seemed to have started from very early interests and were carried on continuously through the years. His style of writing, his handwriting itself, and his working methods changed scarcely at all through the years. His early taxonomic revisions of large genera are as useful as when first published and almost none have been superseded by more recent studies. They are an appropriate heritage from one of our outstanding colleagues.

From the time that Sidney Blake left Harvard to the day of his death he served as botanist in the U. S. Department of Agriculture. His published contributions during this long tenure were numerous, and his unpublished contributions in the form of summaries and reports were of great usefulness to his colleagues. His knowledge of the botanical resources of the Washington libraries was unequalled and his influence toward increasing them substantial. Although he was considerably occupied by routine chores, these were not all distasteful to him. He derived certain satisfaction from his ability to identify impossible scraps of specimens sent to the Department from all over the country, from clarifying fuzzy statements in manuscripts, and from correcting actual errors. He seemed to regret only the disproportion of time to his boundless nervous energy. His prestige in the Washington scientific community was high and he represented the Department in several capacities relating to his particular field. He was an official delegate to the 7th International Botanical Congress in Stockholm in 1950 and spent some months before and after the meetings at European libraries and herbaria. During a short excursion with some French botanists in the vicinity of

the Agricultural School at Grignon the photograph reproduced here was taken.

For the last twenty years of his life Dr. Blake's working time was largely devoted to bibliographical studies which culminated in his two important reference works — Geographical Guide to the Floras of the World — Part I, published in 1942, and Part II, carried through to galley proof at the time of his death, and soon to be published. Many of Blake's colleagues have expressed regret that he devoted so much time to this large task and so little to taxonomy in his later years, and have suggested that some one of lesser training could have done the bibliography equally well. Since I have had the privilege of doing the final checking on Dr. Blake's proofs for Part II I am keenly aware of the size of the effort involved, and tremendously impressed with the care and understanding on which it was based. I am completely convinced that no one who did not want to could have undertaken this work and no one less well trained could have accomplished it. It is my opinion that Dr. Blake was aware of the size of the task when he undertook it and convinced of the value of his contribution to botanists in the future. I do not think that he felt his efforts misspent, nor will future workers in his field.

It was a pleasant and rewarding experience to know and work with Sidney Fay Blake and to have had a small part in the completion of his major work.

VEGETATIVE REPRODUCTION IN CAREX LONGII AND C. VEXANS. — A year or two ago, I reviewed the subject of vegetative reproduction in *Carex tribuloides* and *C. projecta*, giving additional data (Rhodora **61**:294). The same tendency has been found to occur in two more species of *Carex* section *Ovales: C. Longii* and *C. vexans*. Specimens of these two sedges were collected by Dr. H. A. Gleason and myself on 28 April 1960, near Chassahowitzka Springs, Citrus Co., Florida, where several clumps were growing on the flat verge of a cart track along the edge of a wet hammock. Each plant which we examined bore several elongate, prostrate,

over-wintering culms with erect green shoots rising from the nodes. In a few instances the shoots had developed culms with fruiting heads. Incipient rootlets were generally present at the base of the shoots, but had not developed to the point of sustaining growth as independent plants.

For convenience, these collections have been assigned numbers in the records of George R. Cooley, and will be distributed by him, with appropriate label data: *Carex Longii* Mackenz. no. 7323.; and *C. vexans* F. J. Hermann no. 7324.

The latter species was first described by F. J. Hermann as recently as 1955. He cited only four specimens, all from Florida: two from Collier Co. and one each from Hendry Co. and Lake Co. (Rhodora 57:156). It may prove to be rather common in central Florida where within the last two years I have collected it at five widely separated stations. With such a paucity of material, the question of frequency of vegetative reproduction in this species must be deferred.

On the other hand, the former species, *C. Longii,* is relatively common, particularly in the coastal states from southern Maine to Florida, and is well represented in the New England Botanical Club Herbarium and the Gray Herbarium. Of 257 sheets examined, I found only one which displayed any evidence of a tendency to reproduce vegetatively. This is a specimen collected at Indian River, Florida by Ed. Palmer in 1874. It bears an over-wintering culm with prominent nodal fruiting shoots and rootlets, thus providing a second example from Florida, out of a total of thirteen specimens examined from that state. It may be significant that no examples from north of Florida were found, despite the fact that a scattering of collections bore *dead* culms of the previous year, presumably winter-killed.

— Richard J. Eaton, Lincoln, Massachusetts.

RECENT STUDIES IN THE LEGUMINOUS GENUS STYLOSANTHES

Robert H. Mohlenbrock

Since publication of the writer's "A revision of the Genus *Stylosanthes*" in 1957, a number of additions and corrections have been brought to my attention. This paper is an effort to incorporate this material into a supplement to the genus *Stylosanthes*.

In "A Revision of the Genus Stylosanthes", twenty-five species and one subspecies were recognized. Four additional species are presented in this paper, with one being new to science. Several new localities increasing the geographical ranges of some species are given.

Stylosanthes biflora (L.) BSP. — A further listing by states and counties of this United States species is given. ALABAMA: DeKalb, Lee, Marshall, Mobile, Shelby. ARKANSAS: Baxter, Clark, Craighead, Cross, Dallas, Drew, Franklin, Garland, Hot Springs, Jefferson, Johnson, Lincoln, Logan, Miller, Prairie, Pulaski, Saline, Sharp, Union, Yell. DELAWARE: Newcastle, Sussex. FLORIDA: Columbia, Dade, Duval, Escambia, Hillsborough, Jefferson, Lake, Marion, Putnam, Volusia, Washington, Woodson. GEORGIA: Bulloch, Cobb, DeKalb, Fannin, Gwinnett, Madison, Oconee, Stephens, Union, Whitfield. ILLINOIS: Franklin, Gallatin, Hardin, Jackson, Johnson, Lawrence, Macoupin, Monroe, Peoria, Pope, Randolph, St. Clair, Saline, Union. INDIANA: Clark, Crawford, Daviess, Floyd, Harrison, Knox, Lawrence, Perry, Posey, Spencer, Washington. KANSAS: Cowley, Montgomery. KENTUCKY: Bell, Calloway, Carter, Clinton, Edmonson, Estill, Grayson, Lewis, Logan, Lyon, McCreary, Meade, Nelson, Rockcastle, Wayne, Whitley. LOUISIANA: Rapides Parish. MARYLAND: Frederick, Montgomery. MISSISSIPPI: Harrison, Jackson, Stone. MISSOURI: Barry, Benton, Butler, Callaway, Camden, Cape Girardeau, Cedar, Cole, Crawford, Dade, Dent, Douglas, Dunklin, Franklin, Gasconade, Greene, Henry, Hickory, Howell, Iron, Jasper, Jefferson, Lawrence, Lincoln, McDonald, Maries, Marion, Miller, Newton, Oregon, Pike, Polk, Ralls, Reynolds, Ripley, St. Charles, St. Francois, St. Louis, Shannon, Stoddard, Stone, Taney, Vernon, Wayne, Webster, Wright. NEW JERSEY: Burlington, Camden, Gloucester, Hunterdon, Middlesex, Ocean, Salem. NEW YORK: Nassau. NORTH CAROLINA: Cherokee, Cumberland, Edgecombe, Harnett, Henderson, Hoke, Orange, Rowan, Swain, Wayne. OKLAHOMA: Caddo, Choctaw, Comanche, Johnston, McCurtain, Payne, Woods. PENNSYLVANIA: Bedford, Buck, Lancaster, Montgomery, Philadelphia, Schuylkill, York. SOUTH CAROLINA: Aiken, Anderson, Dillon, Georgetown,

Laurens, Oconee, Pickens. TENNESSEE: Bledsoe, Blount, Campbell, Carroll, Cheatham, Cocke, Coffee, Cumberland, Davidson, Fayette, Franklin, Grainger, Hardeman, Henderson, Hickman, Madison, Marion, McNairy, Montgomery, Morgan, Rhea, Roane, Rutherford, Scott, Sevier, Van Buren, Warren, Wayne. TEXAS: Bastrop, Bowie, Brazos, Dallas, Fayette, Harris, Lee, Nacogdoches, Parker, Travis, Walker, Waller. VIRGINIA: Bedford, Smyth. WEST VIRGINIA: Jackson, Jefferson, Lincoln, Summers, Wyoming.

Stylosanthes fruticosa (Retz.) Mohlenbrock. — Through the suggestion of Dr. J. Léonard of Laboratoire de Botanique Systématique, Bruxelles, additional specimens of this entity were examined from Africa and the East Indies with the result that two species should be recognized, instead of only *S. fruticosa*. African material, with loment beaks 1.5-3.0 mm. long and with evenly pubescent stems, should be known as *Stylosanthes mucronata* Willd. East Indian material, with loment beaks 3.5-4.0 mm. long and with unilaterally pubescent stems, should be called *Stylosanthes fruticosa* (Retz.) Alston.

The nomenclatural treatment follows:

Stylosanthes mucronata Willd. Sp. Pl. **3**: 1166. 1800, ex char.
Stylosanthes bojeri Vog. in Linnaea **12**:68. 1838, ex char.
Stylosanthes aprica Span. in Linnaea **15**:192. 1841, ex char. (T: *Burke & Zeyher 404*).
Stylosanthes setosa Harv. in Harv. & Sond. Fl. Cap. **2**:227. 1862, ex char.
Stylosanthes flavicans Baker in Oliv. Fl. Trop. Afr. **2**:156. 1871. (T: *Kotschy 425*).

Known in Africa from Abyssinia, Angola, Kenya, Madagascar, Mozambique, Nigeria, Senegal, Southern Rhodesia, Sudan, Tanganyika, and the Union of South Africa.

Stylosanthes fruticosa (Retz.) Alston in Trimen, Handb. Fl. Ceylon **6**:77. 1931.
Hedysarum hamatum acc. Burm. f., Fl. Ind. 167. 1768, non L.
Arachis fruticosa Retz., Obs. Fasc. **5**:26. 1791.

Known from Ceylon, East Indian islands, and southern India.

Stylosanthes ingrata Blake in Proc. Biol. Soc. Wash. **39**:51. 1928. (T: *S.J. Record s.n.*!). — Through an oversight, *S. ingrata* was listed in synonymy under *Stylosanthes guyanensis* ssp. *guyanensis* by Mohlenbrock (1957), with the statement that it is without fruit. On the contrary, mature fruits are known which place *S. ingrata* phylogenetically near *S. montevidensis*.

Stems herbaceous, usually branched from the base, to 60 cm. long, puberulent, becoming glabrate below. Leaflets lanceolate, acute, with a subulate tip, glabrous or nearly so on both surfaces, mostly 1-nerved; terminal leaflet to 20 mm. long, 4 mm. broad; petioles 4-7 mm. long, puberulent to glabrous, the rhachis 1-3 mm. long; sheath of the stipules usually slightly longer than the teeth, strigose or occasionally with

a few bristles. Spikes linear-oblong, to 10 mm. long, 5- to 8- flowered; outer bracts trifoliolate, the inner unifoliolate, the sheath usually strigose, sparsely bristly, slightly longer than the teeth, 5- to 7-nerved; outer bracteole 1, oblong, to 4.0 mm. long, ciliate near the apex; axis rudiment none; inner bracteoles 2, 2.0-2.5 mm. long. Calyx tube to 3.5 mm. long, the lobe 1.5-2.5 mm. long. Standard obovate, scarcely clawed, to 8 mm. long; wings auriculate below and shortly appendaged within; keel petals falcate. Loment 5-6 mm. long, 1.5-2.0 mm. broad, very faintly reticulate; only the upper articulation fertile, 2.0-3.0 mm. long, glabrous, the lower abortive, pilose; beak slender, uncinate, 1.0-1.5 mm. long, pilosulous or nearly glabrous, slightly more than half as long as the upper articulation.

Known only from the type collection from Vaca Falls District, British Honduras, collected by S. J. Record in February, 1926, and deposited in the U. S. National Herbarium.

Stylosanthes suborbiculata Chiov. Ann. di Bot. **13**:381. 1915. (T. *Paoli 239*!). — At the time of "A Revision of the Genus Stylosanthes," the writer stated (1957) under Excluded Species on page 347 that the type for *S. suborbiculata* Chiov. had not been seen and therefore was excluded from the systematic treatment.

Since that time, the type, which is on deposit in FI, has been studied, and *S. suborbiculata* proves to be a distinct species.

Stems herbaceous to somewhat woody at the base, much branched, spreading to suberect, to 40 cm. long, glabrous or puberulent, at least when young. Leaflets suborbicular, obtuse to slightly retuse at the apex, the terminal to 6 mm. long and 5 mm. broad, the lateral slightly smaller, glabrous on both surfaces, with 3-4 pairs of prominent veins; petioles 3-5 mm. long, glabrous to puberulent, the rhachis 1-2 mm. long; stipular sheaths 5-8 mm. long, 3- to 5-nerved, sparsely setose, the subulate teeth 2-4 mm. long. Spikes narrow, 5-8 mm. long, 2- to 5-flowered; outer bracts trifoliolate, inner bracts unifoliolate, the sheaths stipuliform; outer bracteole 1, 2.5-3.0 mm. long, ciliate near the tip; axis rudiment none; inner bracteole 1, 2.0-2.5 mm. long, ciliate. Calyx tube 2-3 mm. long, the lobes 2-3 mm. long, ciliate. Standard suborbiculate, 4-6 mm. long; wings 3-5 mm. long, auriculate, spurred within at the base; keel petals 3-4 mm. long, falcate. Loment faintly reticulate, 2.0-2.5 mm. broad; only the upper articulation of the loment fertile, 2.5-3.0 mm. long, glabrous; beak uncinate or nearly circinate, 2.5-3.0 mm. long.

This species is known only from the type collection of Paoli (*#239*) from Somaliland.

A NEW SPECIES FROM BRITISH GUIANA. — While studying a recent set of collections of *Stylosanthes* from the United States National Herbarium, a heretofore undescribed species from British Guiana was discovered. It belongs to Section *Stylosanthes*.

Stylosanthes suffruticosa Mohlenbrock, sp. nov.

Herba suffruticosa erecta ad 1 m. alta caulibus ramosis glabris vel puberulis tuberculato-setosis. Foliola elliptico-lanceolata supra glabra subtus parce punctulata glabra vel setosa nervis 3-5 — gemmatis; foliolo terminali ad 10 mm. longo, 2.5 mm. lato; foliolis lateralibus ad 8 mm. longis, 2.5 mm. latis; petiolo 3-5 mm. longo glabro vel puberulo; rhachide 0.5-1.5 mm. longa; stipulae striatae vagina 3-6 mm. longa setosa vel tuberculato-setosa vel glabrata processibus subulato- mucronatis setosis 2-4 mm. longis. Spicae densae oblongoideae floribus 3-10; bracteis unifoliolatis vel trifoliolatis stipuliformibus vagina puberula vel tuberculato-setosa 3-6 mm. longa nervis 5-7; bracteola exteriore 1, 2.0-3.5 mm. longa apice ciliata; axis rudimento ad 4 mm. longo, villoso; bracteola interiore 1, 2.0-3.5 mm. longa apice ciliata. Calycis tubus 3-5 mm. longus lobis 1.5-2.5 mm. longis. Corolla lutea; vexillo suborbiculato 4.0-6.5 mm. longo; alis falcatis 3.0-4.5 mm. longis; carina 3.0-4.5 mm. longa. Lomentum circa 2 mm. latum valde reticulatum, articulo superiore 2-3 mm. longo puberulo, articulo inferiore 1.5-2.5 mm. longo villoso, rostro circa 2.0-2.5 mm. longo parce uncinato.

Stylosanthes suffruticosa is distinguished from *S. hamata* by its tuberculate bristles, from *S. tuberculata* by its two fertile articulations and its longer beak, and from *S. mucronata* of Africa by its smaller leaves and narrower spikes.

The specific epithet is derived from the subshrubby growth habit.

This species is known only from Lethem, Rupununi District, British Guiana.

BRITISH GUIANA: Rupununi: Lethem, *H. S. Irwin 550* (US, holotype), *618* (US, paratype).

Additional locality records for other species of *Stylosanthes* follow:

S. angustifolia Vog. BRITISH GUIANA: Rupununi.

S. hamata (L.) Taub. UNITED STATES: Florida: Duval County.

S. viscosa Sw. UNITED STATES: Texas: Counties of Aransas, DeWitt, Kenedy, Nueces, Willacy. — SOUTHERN ILLINOIS UNIVERSITY, CARBONDALE.

Literature Cited

MOHLENBROCK, ROBERT H. 1957. A revision of the genus *Stylosanthes*. Ann. Mo. Bot. Gard. 44:299-355.

AN UNUSUAL HYBRID HELENIUM[1]

JULIAN A. STEYERMARK

While botanizing in Missouri during 1957, I collected a most puzzling specimen of *Helenium*. Although it most closely resembled *H. flexuosum* Raf., it possessed at the same

[1]Work on this paper was completed during the period when the author received grants-in-aid (G 5623, 7117) from the National Science Foundation.

time the yellow disk corollas and other characters associated with *H. autumnale* L. More detailed examination of the plant indicates that it may be a putative hybrid between *H. flexuosum* and *H. autumnale*, shedding additional light on the matter of the hybrid origin of *H. flexuosum*, as discussed by Dr. Rock in his latest revision of the vernal species of the genus (Rhodora **59:** 101-116; 128-158; 168-178; 203-216. 1957).

In his key to species, Rock emphasizes the "predominantly quadrimerous" disk corollas of *H. flexuosum* with "4 lobes and 4 stamens" as well as the red-brown disk of that species (p. 149). In his description of *H. flexuosum* the "predominantly 4-merous" corolla "(both lobes and stamens)" is again emphasized by italics, and it is stated (pp. 111-112) that "all the vernal species except *H. flexuosum* are characterized by a 5-lobed apex. In *H. flexuosum*, however, the number of lobes is 4, rarely 5. This 5- and 4-lobed condition is further reflected in the anthers. In those taxa with a 5-lobed corolla, the number of anthers is 5 and in *H. flexuosum* the number of anthers is only 4."

Another character of importance is found in the ray-florets, which in *H. flexuosum* are completely devoid of either stamens or style, and the achenes of these ray florets are abortive and sterile. In contrast, in *H. autumnale* the ray florets are styliferous and the disk corollas are 5-lobed. So far as the color of the disk is concerned, the lobes of the disk corollas of *H. flexuosum* are red-brown, whereas in *H. autumnale* they are yellow with a yellow-green to greenish-yellow corolla-tube. Dr. Rock states (p. 112) that "Occasionally, some specimens of . . . . . *H. flexuosum* will have a sordid-yellow disk, rather than red-brown, but such specimens are easily placed on other characters."

The Missouri specimen which appears to represent a hybrid between *H. flexuosum* and *H. autumnale* bears the following data: Howell County: open margins of dried sink-hole pond on south side of road N; T 25 N, R 9 W, sec. 1, 1½ mi. east of Pomona, October 19, 1957, *Steyermark 86003*. This collection has the following characters of *H. autumnale:* 1) 5-merous disk corollas; 2) styliferous ray

florets; 3) yellow disk corollas. The characters of *H. flexuosum* present in the specimen are the following: 1) short stature; 2) stouter and more elongated peduncles bearing relatively few flower heads in a more corymbosely branched inflorescence; 3) more broadly winged stem from base of stem to beginning of floral branches; 4) disk higher than broad and of larger size (in *H. autumnale* usually shorter or more hemispheric); 5) larger and longer disk florets; 6) longer pappus scales which are longer awned; 7) leaf shape with few, broad, short dentations and leaf apex long-attenuate; 8) achenes with longer and denser pubescence than in *H. autumnale.*

From the above, it should be noted that, although the Missouri specimen possesses a greater number of characters which result in its greater resemblance to *H. flexuosum,* nevertheless the three characters of *H. autumnale* which the specimen possesses are highly significant. It should also be noted here that the Missouri specimen further differs from typical *H. flexuosum* in having 1) the disk corollas 3.5-4 mm. instead of 2-3 mm. long, and 2) the pappus scales broadly ovate instead of lanceolate. In *H. autumnale* the pappus scales are ovate and vary from short-awned or merely short-cuspidate to long-awned. In *H. flexuosum* the pappus scales are lanceolate and, according to Dr. Rock (p. 212) "usually acute at the apex so as to form an awn." In the Missouri specimen the pappus scales are definitely awned.

Although it is true that most specimens of *H. flexuosum* show 4-merous disk flowers, it was noted during an examination of material of this species in the University of Missouri Herbarium that some Missouri specimens *(Drouet 793, Drouet 832, Jeffrey* from Boone Co., and *Steyermark 16195* from Putnam Co.) possess both quadrimerous as well as pentamerous disk flowers. At the Howell County locality where the putative hybrid specimen of *Steyermark 86003* was found, both *H. flexuosum* and *H. autumnale* were observed, although the former was the dominant species.

It is interesting to note here that Dr. Rock (p. 116) considers *H. flexuosum* as a species occupying a position morphologically "intermediate between the vernal species of the

southeastern United States and the annual-biennial species of *Helenium* in Texas and Mexico on one hand and the extremely widespread species *H. autumnale*, on the other hand." Although the possession of neutral and sterile ray-florets in *H. flexuosum* is shared by other vernal flowering species of *Helenium*, nevertheless *H. flexuosum* "does not conform to the rest of the vernal species in the remaining characters." (p. 116), and is considered "quite anomalous in many respects, as far as the other species of the section are concerned." (p. 135). One of the eight aberrancies possessed by *H. flexuosum*, as listed by Dr. Rock (p. 136), is that of the flowering period, which, in this species, extends in its range from March through November.

Based upon its "morphological anomaly and ecological diversity" Dr. Rock suggests (p. 136) that "*H. flexuosum* is probably of hybrid origin, long-standing in time . . ." In his hypothetical evaluation of the possible parentage of the hybrid origin of *H. flexuosum*, he indicates his choice of parents as 1) a species of the Section *Tetrodus* "probably the plant known as *Helenium elegans*" and 2) a vernal species, such as *H. brevifolium* or *H. campestre*, indicating *H. campestre* as the more logical choice. He believes (p. 138) that "the origin of the section *Leptopoda* [in which *H. flexuosum* is placed] has been from some styliferous-rayed member of *Helenium* or pre-*Helenium* stock."

The present Missouri collection, discussed above, would indicate hybridization between *H. flexuosum* and *H. autumnale* in portions of the geographical range of these two species. It would also indicate that *H. autumnale* may have played a role as one of the parental sources of *H. flexuosum* to account for the occasional occurrence of pentamerous, yellow-lobed disk corollas and styliferous ray florets of hybrid stock.

Specimens of this collection have been deposited in the Gray Herbarium of Harvard University and in the University of Missouri Herbarium. — INSTITUTO BOTANICO DEL MINISTERIO DE AGRICULTURA Y CRIA, CARACAS, VENEZUELA, AND RESEARCH ASSOCIATE, MISSOURI BOTANICAL GARDEN.

Volume 62, No. 743, including pages 295-324, was issued November 23, 1960.

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